TRANSPORTATION 1980

The Outlook and Issues for Canadian Transportation in the Next Decade

TRANSPORTATION 1980

The Outlook and Issues for Canadian Transportation in the Next Decade

Alan H. Case
Department of Finance
April, 1970

[redacted]

TABLE OF CONTENTS

LIST OF TABLES

LIST OF GRAPHS

CHAPTER I

INTRODUCTION

One of the major fields of government involvement in the everyday life of Canadians is transportation. Every level of government is engaged in the provision of transport facilities, the regulation of rates and company practice, and the operation of transport companies. The federal government alone owns a major railway, Canada's largest airline and its canal systems. It provides facilities and services for air and marine activities, regulatory control of all transport modes within the federal jurisdiction and financial assistance to construction of certain highways. Total direct federal capital expenditures and subsidies on all these activities amounted to about $250 million in 1967. If the capital investments of Crown Corporations were included, the overall investment figures would be considerably higher.

Clearly, with a financial and administrative commitment to transportation of this magnitude, government is continually open to requests and pressures for additional programs in the transportation field. To respond rationally there must be an awareness of new developments in the economy that affect transportation, as well as developments in the transportation industry itself that may affect the nature of involvement by the government.

The Department of Finance, with responsibilities for assessing both the Economic and financial implications of various transportation issues, of necessity requires an overview of possible developments in order that individual proposals can be seen in proper context. The primary purpose of this paper is to develop that necessary overview. In doing this some suggestions are offered as to the type of problems that will arise during what will almost certainly be a period of rapid change in transport technology and economics.

Each of Chapters II to VI examines a separate mode of transport. Chapters VII, VIII and IX depart from this pattern by examining an important aspect of transportation that is not related to a specific mode.

Rail transportation is analyzed in Chapter II and it is generally concluded that even during a period of rapid change in transportation the railroads will probably look basically the same in 1980 as they do today, although there will be some major segments of traffic growth. There may be some major innovations on the passenger side of rail which may in turn create financial and policy questions. However, the most difficult problems are likely to arise from railroad retrenchment and rationalization rather than from new technology.

Chapter III contains an analysis of air transport in the next decade. Potentially, air could create some of the more difficult and challenging governmental problems, mainly because it is the most dynamic mode in terms of market growth and technological innovation. Problems of financing equipment, providing efficient ground facilities, and the side affect problems of noise and pollution will have to be considered during the next decade.

Marine transportation, the subject of Chapter IV, is perhaps viewed as the most traditional of all modes of transport. However, rapidly changing shipping technology caused mainly by the widespread adoption of containers and the rapid increase in the size of ships will change the technology of port development in Canada. The trend to greater ship size may also present an important challenge for the economic operation of Canada's inland fleet as well as the canals that serve this fleet.

In Chapter V highway transportation is studied. Development of highway travel and transportation is not seen to be revolutionary during the 1970's. The basic highway will look much the same in 1980 as it does today, although there may be some important innovations in vehicles. Governmental problems at the federal level will likely concern vehicles and regulatory matters. Pollution and safety questions are two examples of federal concern. In general, the problems that do arise are likely to stem from federal-provincial jurisdiction over certain issues as, for example, with the problems of standardization of regulatory procedures and vehicle specifications.

Chapter VI deals with pipeline transportation. There may be some important advances in solids pipelining in the next decade. However, no major problems are anticipated in this mode from the point of view of the federal government.

Chapter VII deals with urban transportation. It points out a number of areas of possible technological innovation and concludes that growing urbanization in Canada will create continuing needs for initiatives to improve urban transportation.

Chapter VIII highlights the growing trend to intermodal transportation. This is a direct result of containerization. The need for developing policies on container development and transport interchange points such as ports or inland terminals are highlighted.

Chapter IX briefly analyzes some transportation matters that cannot be classified modally or regionally. Among these are recreational transportation, economic development and transportion, and education and research in transportation.

CHAPTER II

RAIL TRANSPORTATION

Rail transport is sometimes visualized as a declining moribund mode of transport that will disappear from the transport scene over the long term. While the ultimate disappearance of rail is probably an exaggerated extension of its public image, there is little doubt that certain segments of the traditional railway business are dying. At the same time rail continues to be the dominant mode of transportation in Canada with a constant 37% share of the market over the past 5 years (Table I). This constant market share has been maintained during a period of rapid expansion of pipelines and ton miles have actually increased from about 76 billion in 1963 to 95 billion in 1968 (Table 1 and Graph 1). This indicates a fairly strong competitive position and probably shows that railroads will have an important role in future economic development in Canada. A simple projection of the upward trend in ton miles during the 1960s (Graph 2) indicates that by 1980 rail ton miles could increase to about 155 billion.

An over-riding feature of the rail outlook in the next decade is its apparent evolutionary development. Unlike air transportation, where fast-paced technological change is typical, changes in rail are likely to be small, cumulative and often unnoticed. Consequently, it is more difficult to identify problems or forecast the future market position.

An illustration of the problem serves to emphasize the difference between air and rail development. With air transportation the advances are in terms of new technology such as the jumbo jet and the supersonics. Such development not only has something of the glamour of science and space age jargon, but lends itself easily to specific identification of problems. On the other hand, discussion of rail development necessarily includes such seemingly mundane items as better management information systems, central traffic control, improved control over the disposition of rail cars, mechanization of maintenance of way and horse power ratings of locomotives. There is no revolutionary innovation among these that points to specific problem areas requiring government attention.

Market Outlook - Passengers

Despite the difficulties of forecasting railway developments, there are some trends apparent at the present time which have important implications for the future. First there is the continuing deterioration of the position of the railways as a passenger carrier. Recent statistics show (Table II and Graph 3) small absolute gains in passenger miles in recent years. When compared to the statistics for air travel, however, the results are not encouraging. In 1968, after the very heavy travel demands of Centennial year, passenger-miles dropped by about 17% while air passenger-miles continued to rise. Rail passenger-miles were only slightly greater in 1968 than in 1960. Air, on the other

TABLE I

Total Freight Ton Miles in Canada
and Percentage of Market of Transport Modes 1960-68

	Trucks Intercity and Local Operation		Commercial Services				Pipelines		
	For Hire Common and Contract	Private and Farm Operation	Total	Rail	Water	Air	Oil Gathering and Trunk Systems	Gas Transport Systems	Total All Modes
	Billions of Ton Miles								
1960	9.98	5.62	15.60	65.45	56.90	.04	20.44	6.44	164.84
1961	11.72	6.27	17.99	65.83	61.43	.05	25.09	9.31	179.70
1962	12.04	6.40	18.44	67.94	70.24	.05	28.37	11.71	196.75
1963	11.97	6.67	18.64	75.80	70.90	.06	29.95	13.23	208.58
1964	12.55	6.94	19.49	86.97	78.02	.08	32.52	15.31	232.39
1965	13.10	7.21	20.31	89.02	76.11	.09	34.72	16.95	237.20
1966	13.54	7.59	21.13	96.83	82.68	.13	38.80	17.94	257.51
1967	14.01	7.71	21.72	94.10	74.64	.13	43.08	19.21	252.88
1968	-	-	-	95.10	-	.17	47.22	22.04	-
	Per Cent Share of Market								
1960	6.1	3.4	9.5	39.7	34.5	-	12.4	3.9	100.0
1961	6.5	3.5	10.0	36.6	34.2	-	14.0	5.2	100.0
1962	6.1	3.3	9.4	34.5	35.7	-	14.4	6.0	100.0
1963	5.7	3.2	8.9	36.3	34.0	-	14.4	6.3	100.0
1964	5.4	3.0	8.4	37.4	33.6	-	14.0	6.6	100.0
1965	5.5	3.0	8.5	37.5	32.1	-	14.6	7.1	100.0
1966	5.3	2.9	8.2	37.6	32.1	.1	15.1	7.0	100.0
1967	5.5	3.0	8.5	37.2	29.5	.1	17.0	7.6	100.0

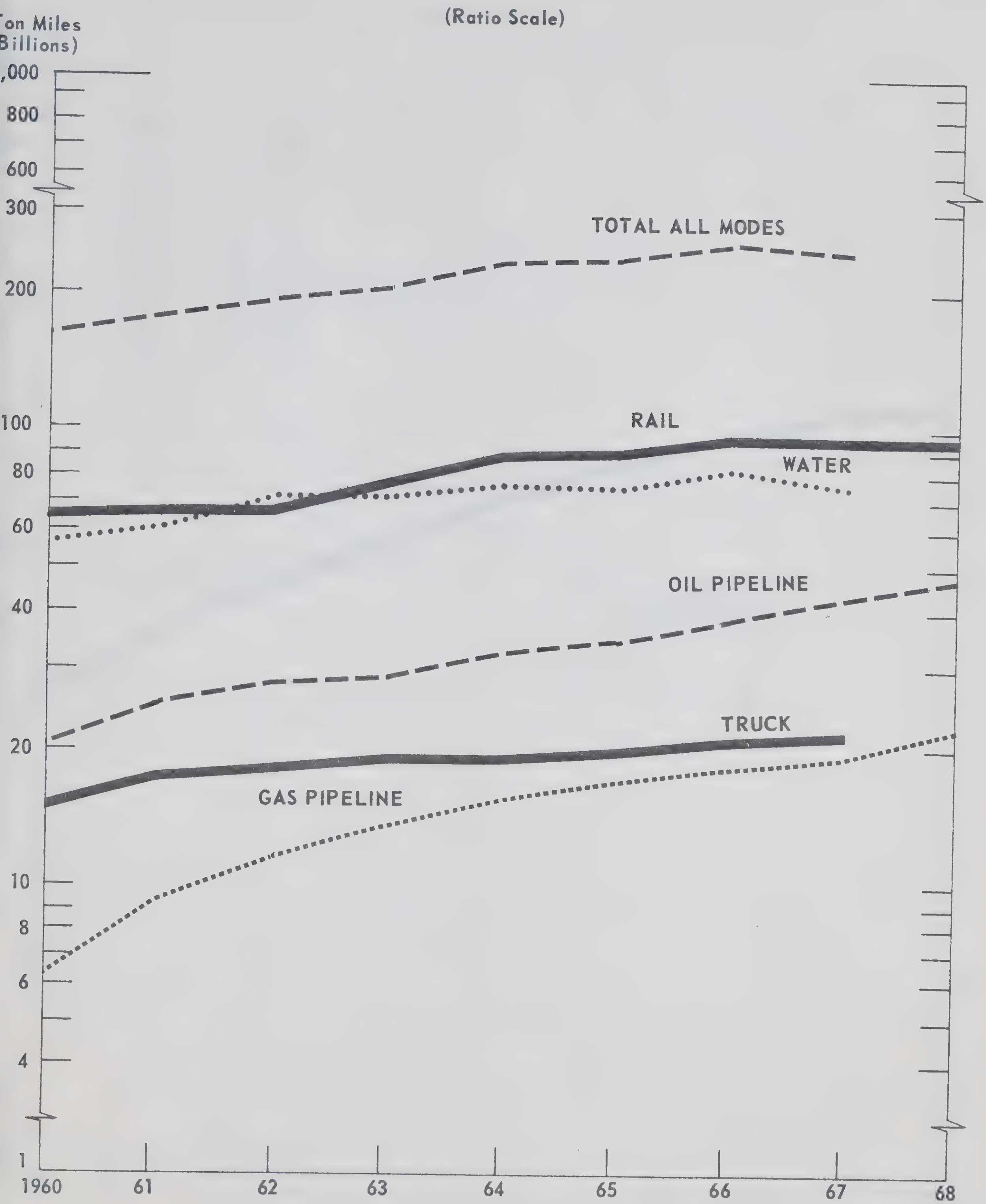
Source: Dominion Bureau of Statistics, Transportation Service Bulletin, Issue 2, March 1970.

GRAPH 1

TOTAL FREIGHT TON MILES IN CANADA

BY MODE OF TRANSPORT

(Ratio Scale)



GRAPH 2

RAIL TON MILES 1960 - 1968

WITH PROJECTION TO 1980

(Ratio Scale)

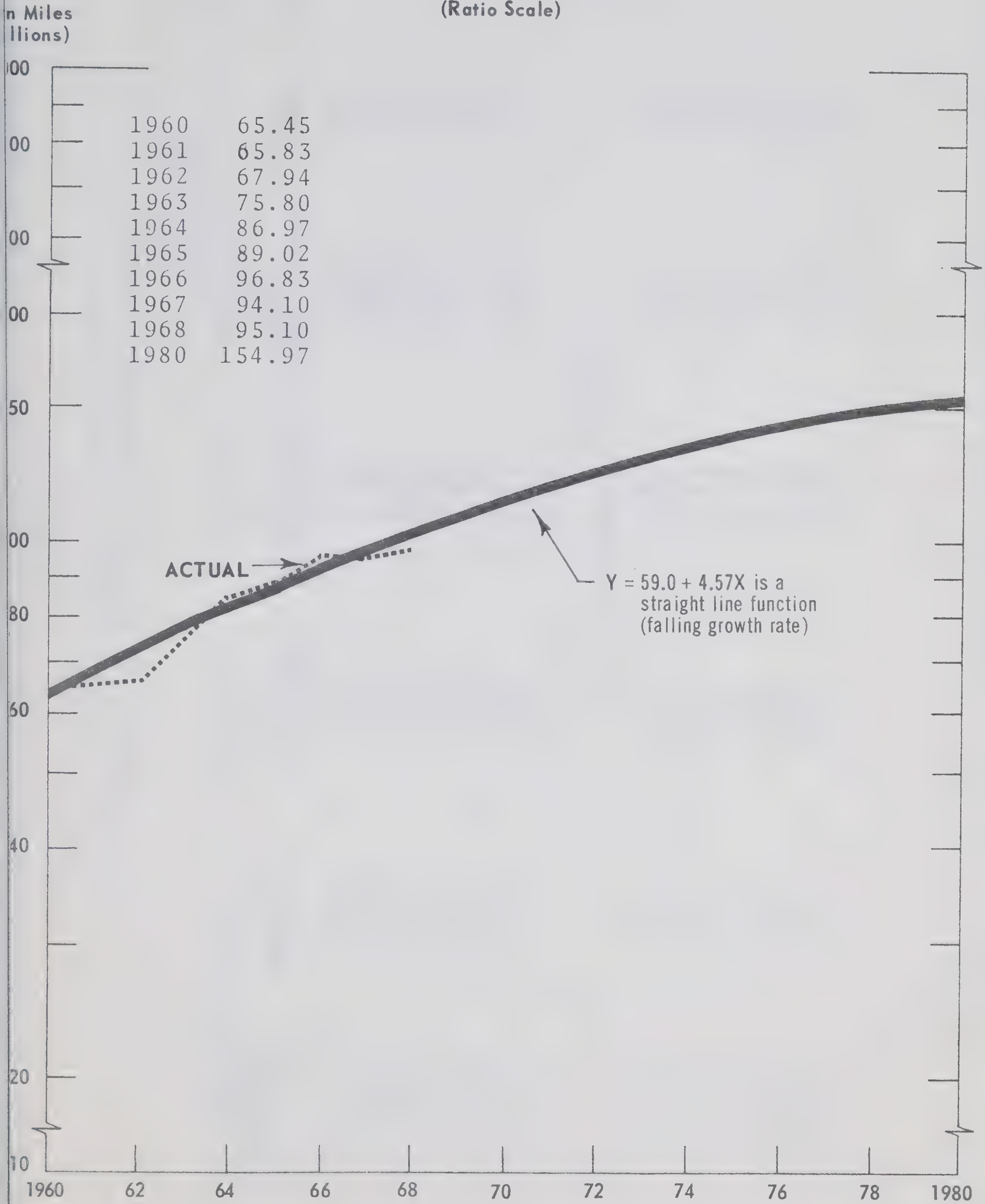


TABLE II

Total Passenger Miles in Canada
and Percentage of Market of Transport Modes 1960-68

	Passenger Cars		Commercial Air Services	Commercial Rail Services	Commercial Bus Services		Other Urban Public Transport	Total
	Canadian Registered	U.S. Visitors			Intercity and Rural	Urban		
	Billions of Passenger Miles							
1960	67.07	5.04	2.24	2.26	1.44	.65	.37	79.07
1961	71.52	5.19	2.61	1.96	1.48	.64	.35	83.75
1962	74.04	5.32	2.80	2.02	1.50	.65	.34	86.67
1963	79.19	5.44	2.91	2.07	1.60	.67	.31	92.19
1964	82.32	4.71	3.20	2.68	1.61	.70	.29	96.51
1965	86.56	5.92	3.67	2.67	1.79	.68	.30	101.59
1966	89.86	6.13	4.38	2.59	2.04	.71	.32	106.03
1967	94.31	6.99	5.53	3.17	2.32	.71	.37	113.40
1968	101.31	-	5.80(est.)	2.63	-	-	-	-
	Per Cent Share of Market							
1960	84.82	6.4	2.83	2.86	1.82	.82	.47	100.0
1961	85.39	6.2	3.12	2.34	1.77	.76	.42	100.0
1962	85.43	6.1	3.23	2.33	1.73	.75	.39	100.0
1963	85.90	5.9	3.16	2.25	1.74	.73	.34	100.0
1964	85.30	5.9	3.31	2.78	1.67	.73	.30	100.0
1965	85.20	5.8	3.61	2.63	1.76	.67	.30	100.0
1966	84.75	5.8	4.13	2.44	1.92	.67	.30	100.0
1967	83.16	6.2	4.88	2.80	2.05	.63	.33	100.0
1968								

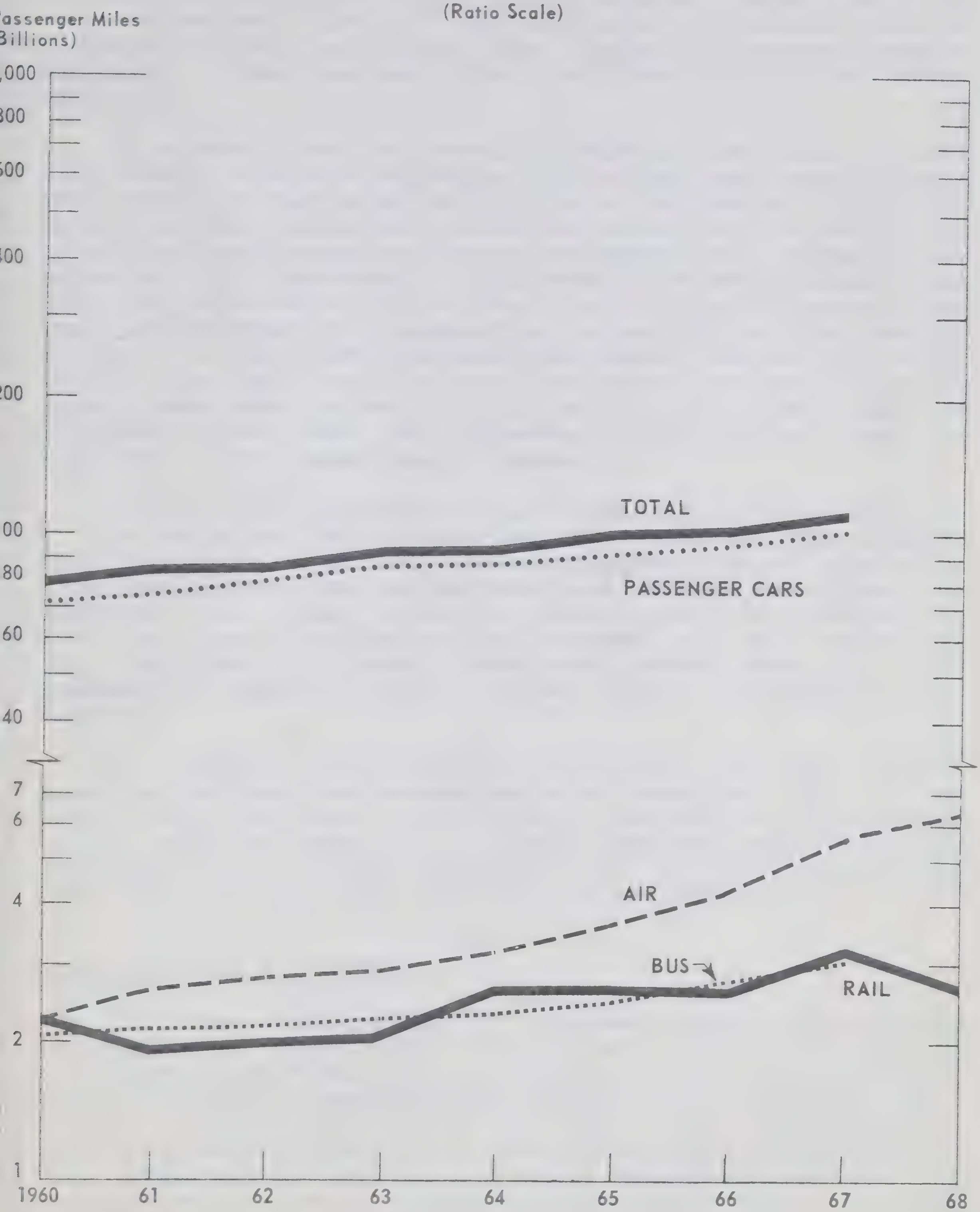
Source: Dominion Bureau of Statistics, Transportation Service Bulletin, Issue 1, November 1969.

GRAPH 3

TOTAL PASSENGER MILES IN CANADA

BY MODE OF TRANSPORT

(Ratio Scale)



hand, grew 2.2 billion passenger-miles in 1960 to 5.8 billion domestic passenger-miles in 1968.

While specific details of the financial position of rail passenger services are not known, it is clear from recent abandonment applications and from other independent studies, that most services are operating at substantial losses. The Canadian Pacific Railway alone claims to be losing about $30 million per year on its present operations. It is not unlikely that the Canadian National Railways could be losing over twice that amount on all its passenger operations. It is also evident from this loss data that the biggest problem in passenger service is the long distance transcontinental services. These account for the great bulk of the losses incurred.

It appears from the overall trends in passenger travel that users will not patronize the current services at fares high enough to make them pay. In this situation, difficult financial and political problems arise with regard to the extent that such services can be abandoned or alternatively supported by government. Ultimately it seems likely that passenger services will disappear over the next decade unless they are provided with substantial direct or indirect subsidy support. If the subsidy alternative were adopted it could involve as much as $80 to $100 million per year based on present services. Given rising costs, the need for new equipment, and lack of patronage, this burden could be expected to move consistently upward.

On the positive side of rail passenger service there is a role which may become more important over the next decade. This is in the area of short distance, high population corridors such as between Montreal and Toronto and Ottawa and Montreal. In cases such as these rail is already an effective competitor and the application of new technology such as the CN Turbo Train may prove that rail can economically capture a much larger share of these travel markets.

In summary, the outlook for passenger services on rail seems to indicate the concentration of services into a few high density corridors. Accordingly, nationwide rail service as it exists today will likely decline except in a few instances where special economic and social factors are important and subsidized services can be justified.

Market Outlook - Freight

In the discussion in chapter VI on the future development of pipelines it is stated that rail is an impressive competitor for pipelines. It is also concluded that for many bulk commodities, other than oil and gas, rail could inhibit the growth of pipelines. For Canadian railways, the implications of this competitive situation are very important. It will probably mean that over the next decade the railways will specialize more and more in heavy bulk traffic.

Canada is a major exporter of bulk commodities such as coal, potash, iron ore, copper and other minerals, all of which seem to have good market growth potential in the next decade. This indicates that there is important potential for growth in tonnages and revenues on the railways. Rail traffic tonnages in the past decade illustrate this trend. In 1958 products of mines (Table III) accounted for about 39% of total tons loaded and in 1968 this proportion had risen to 44%. Manufacturers and miscellaneous goods maintained a constant share at around 30% over the decade and agricultural products decreased as a per cent of the total tons carried.

The growth of the market for rail transportation will depend, to a large extent, on the level of economic activity in the countries where Canada sells raw materials. Foremost among these countries are the U.S. and Japan. Most economic projections to 1980 forecast a period of continuing growth, although any prediction so far in the future is, of necessity, only a very rough estimate. Whatever the compound percentage, be it 3%, 4% or 6%, most forecasts yield very high levels of economic activity. For example in the United States total GNP would be approaching $1.5 trillion by 1980 ($924 billion today) at a 4.5% growth rate per year. In Japan with an expected growth rate of 7.5%, the GNP would be about $250 billion in 1980. If forecasts are correct, this magnitude of economic growth should assure the railways of a continuing and growing market for bulk materials transportation and probably makes the trend line projection in Graph 2 a fairly reasonable projection of rail activity by 1980.

In addition to the growth in demand for transporting bulk materials, there will be increased demand for the transportation of manufactured goods. Rail will share in this growth, although containerization will result in this traffic being handled more like a bulk commodity than the common piece-by-piece handling method practised today. It is quite likely that on selective routes the unit train concept will be applied to transporting containers, thus reinforcing the trend for the railways to specialize in high speed large volume transportation.

A feature of growth of bulk transport on the railways will be its geographic orientation to Western Canada. Potash, sulphur, and coal have only recently begun to move in large quantities from Canada and a large portion of this movement is to West Coast ports from the three western provinces. Additionally, there are the established movements of grain which, over the next decade, will likely move in greater volume through the West Coast ports to serve the growing Pacific market area. This concentration of activity will create pressure on the railways to introduce efficient handling systems if the tonnages are to be moved satisfactorily and the railways are to compete effectively.

The pressure for the railways to become more efficient, particularly in Western Canada, will make it essential to rationalize the present extensive network of branch lines for grain hauling and to adopt the use of unit trains for this

TABLE III

Rail Freight Traffic 1958-1967

Year	Total Ton Miles	Total Tons	Products of Agriculture	Animals & Products	Products of Mines	Products of Forests	Mfgs. & Misc.
	(millions)			(Tons in millions)			
1958	66,356	153.4	29.3	1.6	59.9	14.6	46.5
1959	67,956	166.1	27.9	1.6	71.2	14.7	49.2
1960	65,444	158.5	26.7	1.7	65.5	15.0	48.3
1961	65,828	153.1	28.0	1.6	61.3	14.5	46.4
1962	67,937	160.9	25.2	1.5	68.2	15.4	49.3
1963	75,796	171.7	29.3	1.5	71.8	15.9	52.1
1964	86,974	199.8	35.7	1.7	85.3	17.7	58.5
1965	89,020	206.4	30.4	1.5	92.0	18.4	62.9
1966	96,828	214.6	35.2	1.4	91.2	20.0	65.9
1967	94,101	210.5	29.4	1.4	92.0	21.0	66.0

Source: Dominion Bureau of Statistics, Railway Freight Traffic, (Ottawa, Queen's Printer), Various Issues.

traffic wherever possible. The process of rationalization will create problems because of the consequent economic and social dislocations that will occur in certain communities in the Prairie Provinces.

The problem of reorganizing the branch line network is likely to be more serious after 1975 when the present "guaranteed" network of branch lines implemented by the federal government in 1966 will end. Between now and 1975 most of the uneconomic lines not included in the guaranteed network will likely be abandoned without serious dislocations. However, in keeping with modern unit train and bulk car operations, more drastic cut-backs in the rail network should be contemplated. If the railways adopt new techniques for grain handling such as unit trains and bulk cars, many of the present branch lines will be obsolete in that they would be unable to handle heavy cars. Additionally, and more importantly, the volumes originating at points on these lines will not be sufficient to warrant large rail cars and certainly not unit trains.

The implications of these factors is that fewer rail loading points will be needed, combined with longer truck hauls of grain, either from existing elevators or from the farms to rail loading points. Consequently, the highway and road system will become a more important segment of the grain gathering network, and branch lines will become increasingly redundant.

By 1975 the losses on branch lines will be known and the federal government could possibly be paying annual subsidies of \$20 million or \$30 million per year if abandonment of uneconomic lines is not permitted. The whole question of revamping the grain handling industry in order to reduce the necessity of subsidies and to improve the efficiency of the system is being investigated in a federally sponsored study of the Canadian grain industry that is to be completed within the next two or three years. Some indication of the necessary policy initiatives should arise from this study.

In other areas of Canada, such as the Atlantic Provinces, the question of rationalization and abandonment of rail service may also arise. It is possible that in some cases rail transport could be eliminated altogether without serious economic problems. Alternative modes may be able to provide a faster more economic service. If so the same types of short term dislocation problems are likely to arise as have been identified for the Prairie Provinces.

Technology

As stated earlier in this chapter technological advances in railroading are not likely to impress the general public. The reason is relatively simple: the basic railway as it is known to-day will not change drastically in the next decade. "Of the four principles instituted by the pioneers, namely steam power, the employment of steel-to-steel adhesion, movement in trains, and guidance by contact, the last three named will still constitute the stamp of the railways' originality and the source of their progress."(1)

An important step toward greater efficiency in equipment usage has recently been taken in the U.S. with the decision to develop an "Automatic Car Identification (ACI) System" that should provide rapid location of any freight car on any railroad in the United States. This is a cooperative effort of all railroads to expedite the movement of equipment and to provide better customer service. The system will cost $45 or $50 million to implement and will benefit Canada since both major Canadian railroads are participating with the U.S. railways in the program.

To indicate the efficiency implications of this one innovation, the CNR estimates that the average two-day improvement in car turn-around time that could result, would reduce the equipment requirements of North American railroads by 10,000 new freight cars worth about $120 million.

A second important innovation in railroading of particular importance to Canada is the unit train. Only a few are now operating in Canada but in the next few years others will likely be brought into service for hauling sulphur, coal, iron ore, potash, grains and other minerals where volumes are large enough.

These trains have huge capacities and are used, as a general rule, for one commodity. They operate in a continual shuttle service and are rarely out of service except for routine maintenance. Consequently, the utilization of equipment is very high, permitting low freight rates on the commodities hauled. For example, it has been estimated that the cost may be as low as .35 cents per ton mile for some bulk commodities. Even now rates on sulphur in multiple car loads have been reduced below 1 cent per ton mile and it is estimated that the new CPR unit train for coal between Fernie and Roberts Bank could be operated at a rate slightly higher than .5 cents per ton mile.

Another important trend of rail freight transportation will be the increasing size of rail equipment combined with greater specialization of equipment. The common box car of today will be relatively much less important in 1980. With piggyback and containerization, the flat car will become a more important piece of equipment and where box cars are still used, these will be specialized according to the requirements of particular commodities. For example, they will be designed with special doors for large bulky items, or extra large cars for high volume low weight items. Bulk commodities will be carried in cars that allow for rapid terminal handling. Here too the cars will tend to become larger and may eventually be articulated to allow even greater size.

The most obvious and significant technological changes in railroading are likely to occur in the passenger sector. For example, the new Metroliner, a high-speed electric train, has been operating between New York and Washington since early in 1969. While not a startling technological innovation, this service is generally held to be modern, fast, quiet and in keeping with high standards expected of public transport today. A second high-speed train incorporating greater technological innovation is the Turbo

An important step toward greater efficiency in equipment usage has recently been taken in the U.S. with the decision to develop an "Automatic Car Identification (ACI) System" that should provide rapid location of any freight car on any railroad in the United States. This is a cooperative effort of all railroads to expedite the movement of equipment and to provide better customer service. The system will cost $45 or $50 million to implement and will benefit Canada since both major Canadian railroads are participating with the U.S. railways in the program.

To indicate the efficiency implications of this one innovation, the CNR estimates that the average two-day improvement in car turn-around time that could result, would reduce the equipment requirements of North American railroads by 10,000 new freight cars worth about $120 million.

A second important innovation in railroading of particular importance to Canada is the unit train. Only a few are now operating in Canada but in the next few years others will likely be brought into service for hauling sulphur, coal, iron ore, potash, grains and other minerals where volumes are large enough.

These trains have huge capacities and are used, as a general rule, for one commodity. They operate in a continual shuttle service and are rarely out of service except for routine maintenance. Consequently, the utilization of equipment is very high, permitting low freight rates on the commodities hauled. For example, it has been estimated that the cost may be as low as .35 cents per ton mile for some bulk commodities. Even now rates on sulphur in multiple car loads have been reduced below 1 cent per ton mile and it is estimated that the new CPR unit train for coal between Fernie and Roberts Bank could be operated at a rate slightly higher than .5 cents per ton mile.

Another important trend of rail freight transportation will be the increasing size of rail equipment combined with greater specialization of equipment. The common box car of today will be relatively much less important in 1980. With piggyback and containerization, the flat car will become a more important piece of equipment and where box cars are still used, these will be specialized according to the requirements of particular commodities. For example, they will be designed with special doors for large bulky items, or extra large cars for high volume low weight items. Bulk commodities will be carried in cars that allow for rapid terminal handling. Here too the cars will tend to become larger and may eventually be articulated to allow even greater size.

The most obvious and significant technological changes in railroading are likely to occur in the passenger sector. For example, the new Metroliner, a high-speed electric train, has been operating between New York and Washington since early in 1969. While not a startling technological innovation, this service is generally held to be modern, fast, quiet and in keeping with high standards expected of public transport today. A second high-speed train incorporating greater technological innovation is the Turbo

Train, which operates with gas turbine engines. Its design is based on the application of aerodynamic principles. A number of technical problems have kept these trains out of service to date but when they have been tested sufficiently it is possible they will be placed in regular service on the Montreal-Toronto route.

Even though new motive power is being tested on the Turbo Train the main source of power on the railways will remain the diesel engine in the next ten years. Regardless of whether turbine power is successful on the Turbo Train it will not threaten the place of the diesel for the movement of freight. The basic diesel engine, however, will be increased in efficiency and size with evolutionary improvements.

Government Policy Implications

The most difficult policy problems in rail will arise from attempts to rationalize physical plant and services. This applies particularly to branch line abandonment and passenger services. In both cases there will be trade-offs between continued subsidization and abandonment of services with consequent dislocations in some areas. If services are abandoned appropriate policies may be needed to cushion economic and social effects and perhaps speed the rationalization process.

Some innovative policy problems may also arise in the passenger field. Corridor services with fast trains may prove to be a feasible way to meet heavy travel demands between major population centres. At the same time financing may be beyond the ability of the private sector and local governments. Policy decisions may therefore be required regarding assistance for these innovations and if assistance is provided whether it should be subsidies or repayable loans and how it should be coordinated with assistance to other transport modes.

The government may also have some important decisions to make relating to proposals for construction of pioneer or frontier railways, particularly with respect to northern development. The MOT is currently reviewing the economic feasibility of railway extensions in British Columbia and the Yukon and it may be necessary within the next few years to decide whether or not to risk a large financial outlay for railway extensions in this area.

An interesting area of rail policy that could become a controversial topic is the idea of public ownership of transport rights-of-way. Some transportation economists believe that the only way to make the modes of transport truly competitive is to put them all on an equal footing. This means that the government should own all rights-of-way. The idea applied to railways would be for the government to lease or charge a fee for use of rail right-of-way to whoever wanted to use it. There are myriad practical difficulties in such a concept and it is not likely to be promoted unless circumstances force the issue. For example, if the railways

fail to compete effectively in the next decade and pleas from rail operators to abandon services result, the alternative of relieving the burden of fixed facilities from the operators might be considered as a way to cope with the problem. It is a remote possibility but a very basic policy issue if it should arise.

CHAPTER III

AIR TRANSPORTATION

Air transportation, both cargo and passenger, is the fastest growing mode of transport in Canada. Over the past nine years air passenger-miles increased 2.5 times from 2.2 billion in 1960 to about 5.8 billion in 1968. (Table II and Graphs 3 and 4). Air freight has shown a similarly impressive growth rate although it still remains an insignificant portion (.1%) of the total freight ton miles in Canada. (Table I). In 1960 air freight ton miles totalled about 40 million and by 1968 more than quadrupled to about 170 million ton miles (Table I).

Market Growth-Passengers

Air passenger travel remains the most important segment of airline business and will remain so for some years to come. Furthermore in the next decade it is likely that air will become more and more the dominant commercial carrier for passengers. In 1968 air accounted for about 52% of commercial passenger miles in Canada, whereas in the United States the air traffic share was 64%. Given the limited growth potential for rail and bus services, air can be expected to continue to expand its market share in Canada toward the predominance it now has in the U.S.

The growth of air passenger traffic is mainly a function of two economic variables: gross national product and productivity in the airline industry. Air travel is quite sensitive to fluctuations in the gross national product. As GNP rises both business and personal travel increase, the first because of greater business activity and the second because of increased personal income. Thus, as personal incomes rise a greater proportion of the population will travel by air for personal or recreational reasons. Complementing the effects of external economic factors on air travel are airline productivity improvements. These improvements allow the relative cost, if not the absolute cost, of air travel to decrease.

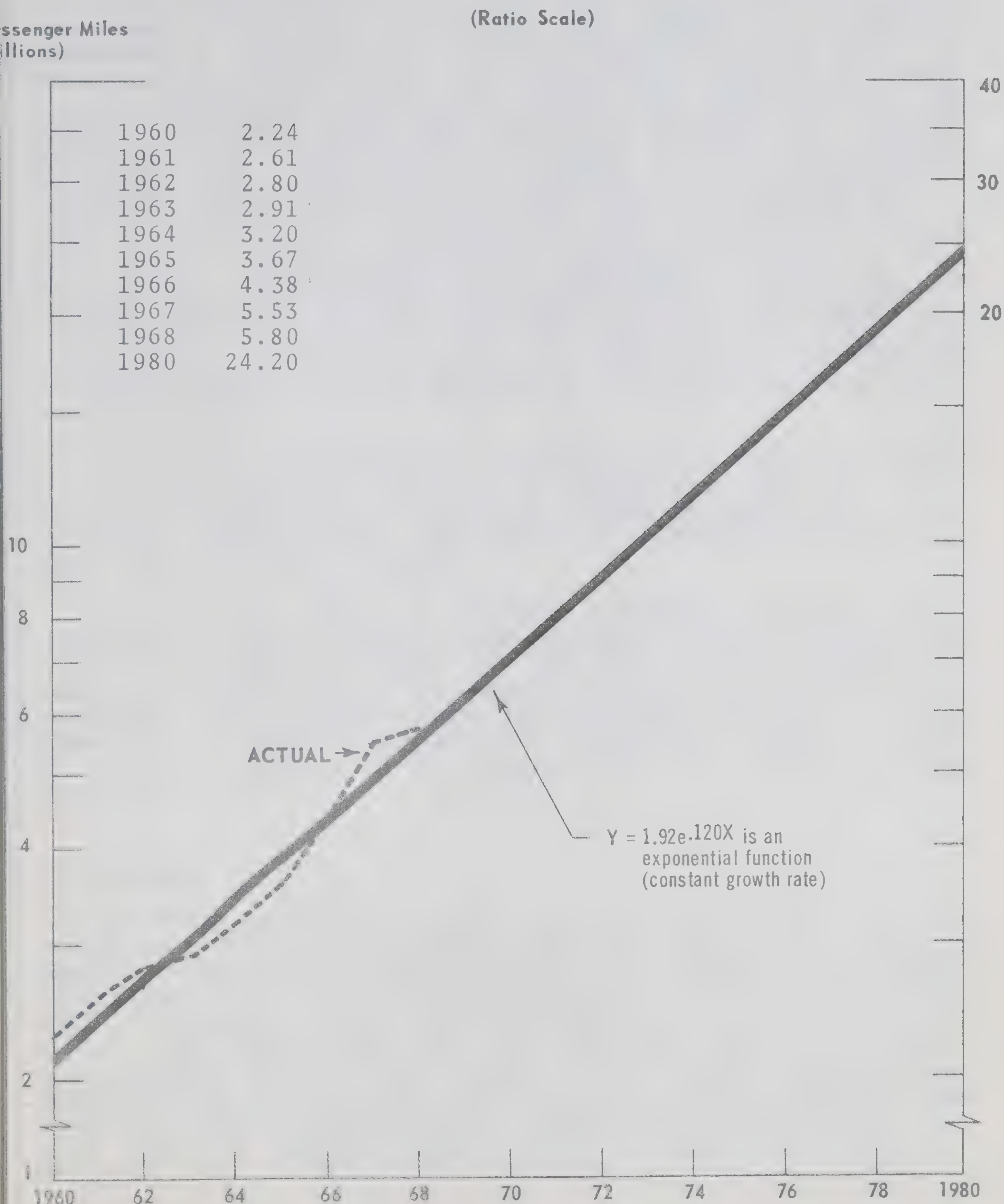
The International Civil Aviation Organization (ICAO) predicts that aircraft productivity will rise at about 13% per year through 1975 and a further 9.5% per year from 1976 through 1980.(1) The effect of these improvements will be to lower operating costs from 16 cents/ton/km to 12.3 cents/ton/km and ICAO predict that these cost savings will be reflected in lower fares on scheduled carriers. Assuming a 2% reduction per year in average fares the cost of travel would fall from 3.5 cents per passenger/km to 2.7 cents per passenger/km.(2) In passenger mile terms the current North Atlantic incentive rates for off-season travel on scheduled carriers are about 4.5 cents per passenger mile. In 1980 rates of around 3.6 cents per passenger mile might be expected, i.e., Montreal to London one-way excursion in off-season for $240 as compared to the present rate of about $300.

GRAPH 4

AIR PASSENGER MILES 1960 - 1968

WITH A PROJECTION TO 1980

(Ratio Scale)



ICAO forecasts that as a result of rising incomes and lower air fares, world-wide air travel will grow at 14% per year throughout the 1970's for a total five-fold increase by 1980. This is approximately the growth rate resulting from a regression analysis and projection of Canadian passenger miles (Graph 4). Another more sophisticated study of Canadian air passenger boardings yielded similar growth rates for Canada over the early 1970's.(3)

One additional factor that should help to sustain market growth at high levels is the trend for the charter companies and travel agencies to market air travel and overseas vacations as a consumer product similar to TV sets or automobiles. There is growing evidence that this is becoming a more important source of growth in air travel. For example, between 1961 and 1968 the number of charter passengers on Trans-Atlantic flights to and from Canada increased from 42,453 to 353,553.(4) This represented a compound growth rate of 35.4% per year in comparison with a rate of 13.3% for all international scheduled services to and from Canada. (from 2.0 million passengers in 1961 to 4.8 million in 1968.) Further, even more rapid growth, occurred in 1969 when about 573,000 passengers were carried across the North Atlantic. This was a 62% jump in one year and represented about two thirds of the total of 736,000 passengers that travelled the North Atlantic to and from Canada in 1969.

On all international flights from Canada in 1968 charters accounted for 8.5% of all passengers. In the U.S. the corresponding figure was 17.0%. This suggests that there is still considerable latitude for further growth in this particular market in Canada.

Whether the growth of charter passenger traffic will continue at a high level is unpredictable since it depends on the competitive tactics of the scheduled carriers in attracting customers. It seems clear, however, that marketing of low travel fares and complete holidays, whether undertaken by charter companies or scheduled airlines, has considerable potential to expand the total market for air services.

Air Freight

In terms of year-to-year percentage changes, air freight growth is even more impressive than passenger growth. Over 5 years between 1963 and 1968 domestic air freight ton miles multiplied 2.5 times in Canada (Table I) and throughout the world a similar increase (20.5%/year) has prevailed.(5) During the same period rates have fallen about 4% per year. ICAO predicts that in the 1970's rates will continue to decrease by about 2%/year and yield average increases in traffic of about 16% per annum. Under these assumptions by 1980 world air freight traffic would be seven times the 1967 level.

The rapid growth of air freight traffic is based on the introduction of new types of aircraft with important potential for improving the economics of air carriage. The current industry average ton mile cost for all aircraft is about 17 cents per ton mile. The Boeing 707 and DC8 however, can operate in all cargo service for about 13 cents per ton mile. The Boeing 747, which will have a cargo capacity of 100 tons or about double the capacity of a DC8 or Boeing 707, has an estimated operating cost as low as 9 cents per ton mile. Larger aircraft may reduce this even further.(6)

Based on these rapid cost improvements, ICAO has estimated(7) that air freight could grow by 10 times by 1980, i.e. about 72 billion ton kilometres world-wide (and possibly 1.7 billion in Canada). Other recent forecasts confirm that an 8 to 10 fold increase in air freight by 1980 is a reasonable expectation.(8) This incidentally will still represent a small proportion of freight ton miles in Canada, probably not exceeding 1% of the total.

Technology - New Aircraft and Airport Support Facilities

The previous section predicted an optimistic future for air transportation. It is clear that the favourable outlook is due in large measure to the assumption that aircraft will be introduced in the next decade that will greatly improve efficiency. This section outlines some of these technological improvements that are currently envisaged.

The Boeing 747 is the first new aircraft to be introduced in the 1970's. It will be capable of carrying about 500 passengers, more than twice the number of passengers of any previous airliner, although most operators will likely use a configuration of about 350 passengers. This $22 million aircraft will come into wide use in the early 1970's on the high-density routes such as the North Atlantic. About 160 Boeing 747's have been ordered and by mid-1970 about 2 per week will be completed and delivered to the airlines.

In addition to the Boeing 747, other kinds of wide bodied aircraft will come into wide usage during the 1970's. Two types are currently being sold, the L1011 which Air Canada has commitments to purchase from Lockheed, and the DC-10, a McDonnell-Douglas airplane. Both aircraft are designed for high-density medium-distance routes and will carry between 250-300 passengers in a wide body configuration similar to the Boeing 747 "jumbo jet". Larger versions of these aircraft will be designed for longer distances and capacities of up to 375 passengers.

Further in the future, but a distinct possibility for the late 1970's, is an even larger subsonic jet that could carry up to 900 passengers. This aircraft could be a passenger version of the C5A now being built for the U.S. Department of Defense, but development costs have been extremely high, rising from an initial estimate of $1.5 billion for 58 aircraft to $3.0 billion. Whether a civilian model can be developed for commercial markets is uncertain, given these over-runs in cost and the concern of U.S.

authorities to contain or halt any further cost increases. In any event, the plane would have to demonstrate economic advantages to the airlines before orders would be placed.

The other significant aircraft development for the 1970's is the supersonic. Both Russian and Anglo-French prototypes are now flying, and both have been tested at supersonic speeds. The Anglo-French Concorde will probably come into use around 1974 at a cost per airplane of about $25 million. This plane is designed to carry about 135 passengers at up to 1400 m.p.h. Still on the Boeing Company's drawing board is a U.S. version of a supersonic aircraft, the Boeing 2707 that would travel at 1800 m.p.h. and carry 280 passengers. Development costs have risen well beyond early estimates due to some serious design problems. Progress was delayed recently while the U.S. supersonic program was re-evaluated. However President Nixon recently gave approval to go ahead with the next step in the development of an American supersonic but it will be at least 1978 before the Boeing 2707 is ready for commercial use.

These predictable changes and improvements in flying equipment will clearly make vast changes in air travel convenience and comfort. At the same time a new range of problems for both the airlines and governments will arise from these technological advances. A general feature of these difficulties is that the rapid introduction of technological improvements in flying equipment, from turbo props in the early fifties, jets in the late fifties, stretched jets, jumbo jets and supersonics in the early 1970's has not been accompanied by equivalent advances in air travel support facilities. The result has been the achievement of fast point to point flying times but in some instances congestion at either end of the journey that offsets the advantages of high speed.

In some cases the political and institutional machinery to deal with such problems has not been adequate, particularly in the provision of ground facilities. A good example is the provision of new airports. In Canada this is a problem within the federal jurisdiction but it overlaps into provincial and municipal jurisdictions such as highway access and municipal zoning. The result can be conflict between differing interests and consequent delay in establishing needed facilities.

Another representative problem is aircraft noise. Those creating the noise, the manufacturers and airline companies, have little direct interest in its control. Those that are most affected have little direct say in the design of aircraft engines.

It is a matter of debate whether all the expressed inadequacies of support facilities for air travel is a bad thing. The other side of the question is whether the forces pushing technological change should not themselves occasionally pause to allow support functions to keep pace. Alternatively they might design their product to minimize the need for new facilities. A new and better aircraft should not automatically cause a long series of airport improvements, ground equipment additions, etc., just as a car

designed to travel at 150 m.p.h. should not necessarily cause freeways to be built to allow safe operation at that speed. Certainly, a massive concentration of resources into air travel, if desired, can be accomplished, but priorities sometimes demand that expenditures be allocated to other areas. Accordingly it should be anticipated that air travel will continue to function, as an overall system, somewhat less smoothly than the efficiency of the flying machines in the system.

Other problem areas arising from the introduction of new subsonic and supersonic jets concern the ability of these aircraft to cause widespread pollution. There is, however, considerable evidence that the pollution and noise problems of at least the subsonic jets can be solved. Under the prodding of the U.S. Federal Aviation Administration and recent regulations with respect to noise and air pollution from this agency the new large jets will be both quieter and cleaner than the present B707s and DC8s. In fact the B747 is about 10 decibels quieter than either a DC8 or B707, which amounts to a 50% reduction in an indivuduals awareness of noise. The DC10 and L 1011 will be even quieter and should be well within the limits set by the F.A.A. All of these new aircraft will create much less air pollution than present airplanes even though the engines are much bigger and more powerful. In addition, over the next 5 years, aircraft now operating will be required to reduce noise and air pollution to acceptable levels.

In Canada no noise or pollution limits have, as yet, been established but it is a problem that is being studied at the present time.

Another problem that cannot yet be defined is the sonic boom that will be caused by supersonic jets. If it proves to be a serious difficulty the noise problem will extend to aircraft flight paths, not just the airport vicinity presently affected by noise. In addition there is an undefined problem of noise of supersonic jets at subsonic speeds which is an even more difficult technical problem than reducing noise in subsonic jets.

All of these issues related to the effect of aircraft on human environment will be difficult to resolve. More than with other problems, political considerations are important and solutions may be based on the politics of environmental quality more than economic criteria of airline operation. The location of the Montreal Airport is a current Canadian example. Of course, the airlines perceive any restrictions on their activities in terms of economics, i.e., the imposition of higher costs. However, costly restrictions may provide an incentive to the companies and manufacturers to devote more resources to solving noise and air pollution problems. The other alternative is for the government to support or initiate research programs aimed at solving these difficulties. Ultimately the government may have to decide which is the best approach to the problem; a strong regulatory effort or a more positive direct involvement is actually seeking answers to the problems through financially supported research and development.

VTOL and STOL Aircraft

An important segment of the travel market that is presently largely undeveloped by commercial aviation is the short distance market of between 150 and 300 miles. The chief reason is that, with existing aircraft and airports, time savings over other modes are not significant. This disadvantage can be overcome with either vertical takeoff and landing (VTOL) or short takeoff and landing (STOL) aircraft that are designed to land on small airfields that can be much more conveniently located in urban areas than is possible at the present time. Thus the short distance traveler could be provided with a convenient departure and arrival location.

The chief hindrance to the development of this type of service has been the lack of a commercially viable VTOL and STOL aircraft. As yet a suitable VTOL is not a prospect but some progress has been made in developing STOL vehicles. It seems likely, therefore, that some technical breakthroughs could occur in the next decade which will encourage the development of economic short distance air travel.

Short distance air travel with VTOL and STOL vehicles would require new airport facilities separate from present large airports but designed to work in conjunction with these facilities. Because of the technical features of these vehicles ground support facilities in large centres could be dispersed and small areas within the urban area could be used for landing STOL and VTOL airplanes.

Capital costs of VTOL and STOL aircraft should not be as high as jet aircraft nor, of course, will they be as productive in terms of seat miles produced in a year. However, once an economic vehicle is developed Canadian carriers would probably find it relatively easy and attractive to enter the short distance intercity markets such as Montreal-Ottawa, Montreal-Toronto and Toronto-Ottawa.

Canadian Equipment Requirements

Plans of Canadian airlines for acquisition of new aircraft over the next decade illustrate the magnitude of financial problems that are occasioned by the increased demands for air transportation. Air Canada and C.P. Air together propose to budget almost one billion dollars over the next decade for new equipment. (Table IV). In addition, purchases of conventional jet equipment by regional carriers will increase the overall investment requirements.

Air Canada is by far the largest purchaser of equipment. In the next two years it is committed to buy DC8 and DC9 equipment valued at $264 million. In addition three jumbo jets worth $69 million are scheduled for delivery in 1971 and 11 L1011's worth $165 million in 1972-73. In addition to these orders, delivery positions have been established for four Concorde supersonics and six Boeing 2707 supersonics, potentially worth about $350 million. C.P. Air has plans to purchase the Boeing 2707 supersonic but, because of the need to be competitive with supersonics, may opt for the Concorde if the U.S. aircraft is delayed too long.

TABLE IV

Presently Planned Canadian Commercial Jet Purchases
1968 - 1980

	Type of Aircraft	Number Ordered	Year of Delivery	Cost Per Unit ($ millions)	Total Cost ($ millions)
Air Canada	DC-863	13	1969-70		
	CC9	8	1969-70		264
	B747	3	1971	23	69
	L1011	11	1972	15	165
	Concorde	4*	1973	25	100
	B2707	6*	1978	40	240
				TOTAL	820
CP Air	727-100	2	1970		
	B2707	3	1978	40	120
Pacific Western	B737-200	1	1970		
Trans-Air	B737-200	2	1970		
	B727-100	2	1970 (possible)		

* Delivery positions reserved but orders not placed.

Air Canada purchases have the greatest financial implications for the federal government. Unless Air Canada obtains financing on the open market there will be a requirement for the federal government to provide new loans of up to $580 million before 1975. With borrowing requirements at such a high level, the issue of whether Air Canada should seek open market financing may continue to be discussed.

Canadian Ground Facilities Requirements

A very expensive and continuing commitment for the federal government, is the provision of adequate ground facilities to handle increased passenger volumes and more sophisticated aircraft. Over the next decade, major expenditures on new airport and support facilities will be required in Montreal and Toronto. In order to cope with expected traffic growth, the new facilities will require continuous development over 10-20 years. By 1985 it is estimated that $276 million will have been spent on the new Montreal airport and $380 million on a Toronto airport. Almost $200 million of this capital will be required during the early 1970's.

Investments of this magnitude naturally raise some difficult jurisdictional problems. Such investments can incur heavy support investments such as airport access and this is raising problems of who should pay for these access roads. Then too there is the problem of actual location of new facilities, a decision that can have a major influence on economic development in an urban region.

The prospect of these heavy capital requirements has raised the question of how money should be provided in future for airport development and how investments in these facilities can be established on a self-sustaining basis. It is a question that has not yet been fully resolved although an initial step to raise additional revenues from air travel has already been taken in the recent decision to impose new taxes on air tickets, possibly in 1971.

Canada's commitment to air facilities, of course, goes far beyond the provision of air terminals in the two major cities. There will be requirements for new and modified terminals in other Canadian centres. These facilities will also be costly. Furthermore modern aircraft require more sophisticated ground-based navigational equipment. Recent expenditures on this type of equipment illustrate this trend. (Table V). In 1956 only about $3 million was spent on navigational aids. By 1962 the expenditure had reached $14 million and in 1964 amounted to $20 million (coinciding with the introduction of jet aircraft and a heavy airport construction program). In 1968 expenditures had declined somewhat to $10 million.

TABLE V

Federal Government Expenditures
on Airport Construction and Navigational Aids

Year	Radio and Navigational Aids	Airport Construction
	$ Thousands	
1968	10,142	48,893
1967	12,548	52,016
1966	14,981	25,005
1965	14,914	22,662
1964	19,931	27,709
1963	8,786	48,748
1962	14,369	60,900
1961	8,855	53,018
1960	9,998	52,443
1959	8,631	53,151
1958	8,430	34,945
1957	4,397	26,309
1956	2,986	20,381
1955	2,308	10,209

SOURCES: Public Accounts of Canada. Ottawa, Queen's Printer, Various Issues.

Department of Transport. Annual Report. Ottawa, Queen's Printer, Various Issues.

In addition to providing for more sophisticated aircraft the government will have to provide for increased private flying. In a recent Department of Transport Study (9) it was shown that total aircraft numbers in Canada had grown from 5803 in 1961 to 9098 in 1967. Only about 2800 (31%) of the 1967 total were commercial or state aircraft. The remainder were private. This same study predicts that by 1980 there will be about 17,500 aircraft in Canada and the private proportions will have risen to 75% from the present 69%. In terms of hours flown however, it is predicted the private share will fall from 27.5% in 1967 to 23% in 1980. However this still represents a 75% growth in total private flying hours by 1980.

This growth in private flying clearly raises basic questions of planning accommodation for private flying and whether it should be in large airports or at special facilities. Closely related to this is the regulatory and safety problem of separating private planes from large commercial aircraft and whether this can be done by regulatory prohibition of small private planes from large airports or whether a choice should be left to the operator but charges levied that are more closely related to actual costs i.e., much higher charges than at present, and thus resulting in a strong deterrent to small planes using major airports.

Government Policy Implications

The expansion of the air industry in Canada will require a constantly increasing federal involvement in terms of facilities and capital. The demands of Air Canada alone will be a major financial commitment throughout the 1970's. These heavy investments will lead to policy questions involving the division of routes between carriers, both within Canada and to other countries, that will affect the efficient use of these equipment investments. For example, Canada currently has two national flag carriers on foreign routes: Air Canada and Canadian Pacific. Questions of how to assign available foreign routes to allow both to operate economically will be important. An even more basic question that may also arise is whether two Canadian foreign carriers are in fact justified.

The development of regional carriers will also pose a continuing policy problem to the government with its interest in protecting the viability of Air Canada's operation while at the same time promoting an appropriate environment for the growth of profitable regional airlines. The assignment of territory to the regional carriers has been decided but the questions of which routes Air Canada can relinquish to regional carriers within the region still remain to be settled. There is also the additional consideration of the degree of competition that should be encouraged on routes that are already serviced by Air Canada and C.P. Air.

Heavy commitments to physical support facilities will also present continuing financial demands and accompanying policy questions of how they should be paid for. There may

also be policy questions related to the efficiency of usage of facilities, i.e., some types of inefficient users should perhaps be discouraged from using certain facilities which heretofore have been open for all to use. The previously mentioned problem of private aircraft using major airports is a good example.

Finally, there are a number of questions relating to new technology. Jet engine noise and air pollution from existing aircraft as well as the forthcoming new subsonic jets are problems for consideration in the near future. Supersonics will have the additional factor of the sonic boom which may expand the noise problem far from the airport areas. The government is aware of these developing problems and will no doubt find it necessary to take firm policy decisions to control them. The outcome will significantly affect the selection of aircraft and airport sites and the ability of the air transport industry to perform efficiently.

CHAPTER IV

MARINE TRANSPORTATION

Canada's involvement in water transportation is limited to inland and coastal waters, with virtually no Canadian activity in deep-sea shipping, although there is extensive support for deep-sea vessels, through harbours and navigational aids. In 1968 the federal government alone spent $191 million (TABLE VI) on a variety of marine facilities and subsidies. When private investment is included the total outlays for marine facilities and subsidies in 1967 were $237 million. Clearly, the Canadian government and private industry invests heavily in the provision of facilities for inland and deep-sea ship fleets, but does not invest in the deep-sea fleets themselves. Requirements in Canada for these vessels are met through the world market for ocean vessel transportation. Despite this current situation, the question of a Canadian-owned ocean fleet could present one of the most serious policy questions in marine transport over the next decade.

World shipping is a vital factor in economic life in Canada. This will continue in the next few years because of the importance of exporting raw bulk materials. Hence the development and availability of efficient, modern bulk cargo vessels is of vital importance to Canada's competitive position in raw material markets. A second reason for the importance of world shipping developments is the implications for investment, particularly port investment, that Canada will have to consider in order to adapt and take advantage of advanced shipping technology. This second aspect will be discussed in the chapter on intermodal transportation.

Inland shipping is a relatively important mode of transportation within Canada. In 1967 about 29% of total ton miles (TABLE I) in Canada was performed by water transport. This percentage share of the market has declined slightly over the past 5 years from about 34% in 1963. A regression analysis of past trends of water ton miles within Canada indicates a falling growth rate (Graph 5) and an increase by 1980 of only about 20 billion ton miles over the 1967 level of 74 billion ton miles i.e. only a total increase of about 27% in 12 years.

Shipping Technology

Ocean shipping is currently undergoing a period of very rapid technological change. The most obvious feature of this change is the rapidly increasing size of ships, particularly tankers, that are being built. In 1968, 72% of the tanker tonnage on order was for ships larger than 150,000 tons.

Accompanying the greater ship size are trends to automation which are reducing crew requirements to very low levels. A study recently completed for the National Harbours Board(1) by Dr. T.D. Heaver concluded that crew size is no longer directly related to vessel size but rather to the

Table VI

Federal Government Investments
in Marine Transportation 1964-1968

	1964	1965	1966	1967	1968
			$ millions		
Harbours and Rivers Construction & Dredging (DPW)	16.8	23.3	27.8	30.0	36.1
Marine Services DOT	25.8	25.2	40.0	49.3	46.3
Steamship Services Nfld. & P.E.I. ferries capital & subsidies DOT	1.4	10.2	23.8	27.3	24.5
National Harbours Board (construction, dredging, etc.)	6.9	3.4	4.3	23.7	21.7
St. Lawrence Seaway	3.9	15.4	26.4	17.9	23.7
Shipbuilding Subsidies	40.0	32.0	40.5	35.8	39.3
Total Federal Investment	94.8	109.5	162.9	184.1	191.7
Private Investment	63.1	58.7	55.2	53.6	
Total	157.9	168.2	217.1	237.7	

Sources: (1) Public Accounts of Canada Various Issues.

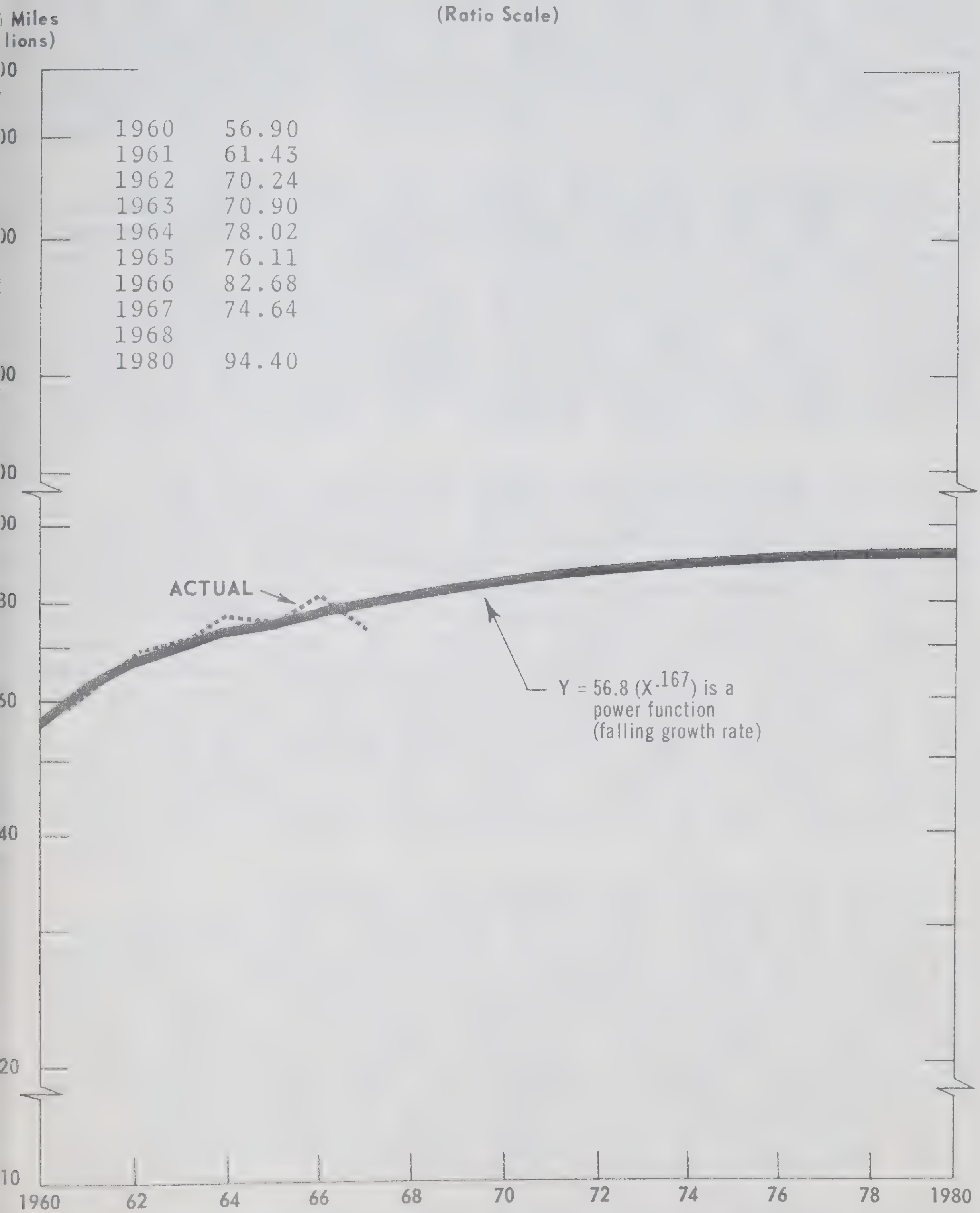
(2) Dominion Bureau of Statistics, Water Transportation (Ottawa, Queen's Printer), Various Issues.

GRAPH 5

WATER TON MILES 1960 - 1967

WITH PROJECTION TO 1980

(Ratio Scale)



degree of automation applied in the vessel. Thus there is an economic tradeoff between greater fixed capital cost and greater variable crew costs.

This potential tradeoff between variable and fixed costs is significant in the Canadian context in that, traditionally, the reason for Canada not having a merchant fleet was the relatively high cost of Canadian-built ships and Canadian crews compared to other countries. However, if crew costs can be offset with automation it could mean (and this is only a possibility) that previously high operating cost countries such as Canada might have more opportunities to successfully enter the merchant marine business. This would be even more likely if the vessels could be built in highly efficient shipyards such as Japan, and registered in Canada.

It is hard to foresee great benefits accruing from a Canadian flag fleet but even if costs were approximately equal to the world fleet, potential foreign exchange savings would lend some weight to arguments for a Canadian fleet. This matter is currently under study in the Canadian Transport Commission. If the results of the study support the establishment of a fleet it could raise some difficult policy issues. For example, how should a Canadian fleet be developed, should it include a domestic shipbuilding program and should carriage of Canadian trade be restricted to Canadian vessels?

There is no doubt that large vessels (tankers of 200,000 + tons and bulk carriers of 50,000 + tons) represent a very significant technological and economic advance at both the construction and operational level. An example at the construction stage is a Japanese shipyard where, in 1968, a 200,000 ton tanker could be launched in a period only 1! times longer than it took to launch a 50,000 ton tanker 5 years earlier.(2) Once the two vessels were in operation the smaller vessel would cost about $2.71 per ton to operate over a 10,000 mile round trip with four days in port. The same trip for a 200,000 ton vessel would cost about $1.36 per cargo ton (TABLES VII and VIII). Similar conditions applied to a bulk vessel would result in a cost per cargo ton of $2.99 for a 40,000 ton vessel and $1.94 for a 100,000 ton vessel.

There is currently speculation that vessels as large as one million tons might be built and there is at least one planned that is 500,000 tons. It seems unlikely, however, that such large vessels will come into wide use during the next 10 years. They will in all likelihood be restricted to specialized trade routes under long-term leases. One reason is the limit to economic savings in greater size. The decrease in cost per ton between a 200,000 ton and 300,000 ton tanker is only 25 cents per ton on a 15,000 mile round trip voyage, (TABLE VIII) whereas the difference between a 100,000 ton and 200,000 ton tanker is 72 cents per ton. Clearly there are definite reducing returns to scale.

Heaver concluded that a majority of new dry bulk vessels would not exceed 100,000 tons for a number of years.(3) The

TABLE VII

COST PER CARGO TON - TANKERS

A. 5000 Miles

Vessel Size	Port Days 4	7	10	14
25000	2.27	2.59	2.92	3.36
50000	1.49	1.71	1.93	2.22
75000	1.19	1.37	1.55	1.78
100000	1.02	1.17	1.33	1.53
150000	0.84	0.97	1.09	1.26
200000	0.75	0.87	0.98	1.13
300000	0.66	0.76	0.86	1.00

B. 10000 Miles

Vessel Size	Port Days 4	7	10	14
25000	4.14	4.48	4.81	5.25
50000	2.71	2.93	3.15	3.44
75000	2.16	2.34	2.52	2.76
100000	1.85	2.01	2.16	2.36
150000	1.51	1.64	1.77	1.94
200000	1.36	1.47	1.59	1.74
300000	1.19	1.29	1.39	1.53

C. 15000 Miles

Vessel Size	Port Days 4	7	10	14
25000	6.07	6.40	6.74	7.19
50000	3.95	4.17	4.39	4.69
75000	3.15	3.33	3.51	3.75
100000	2.69	2.85	3.00	3.21
150000	2.20	2.33	2.46	2.63
200000	1.97	2.08	2.20	2.35
300000	1.72	1.82	1.92	2.06

D. 25000 Miles

Vessel Size	Port Days 4	7	10	14
25000	10.05	10.40	10.74	11.20
50000	6.49	6.72	6.94	7.25
75000	5.16	5.34	5.53	5.77
100000	4.40	4.56	4.72	4.92
150000	3.58	3.71	3.84	4.02
200000	3.20	3.32	3.43	3.59
300000	2.79	2.90	3.00	3.14

Source: T.D. Heaver, The Economics of Vessel Size, National Harbours Board, 1968.

TABLE VIII

COST PER CARGO TON - BULK CARRIERS

A. 5000 Miles

Vessel Size	Port Days 4	7	10	14
10000	$4.05	$4.65	$5.25	$6.05
20000	2.60	2.99	3.38	3.89
40000	1.65	1.90	2.14	2.47
60000	1.37	1.58	1.79	2.07
80000	1.19	1.37	1.55	1.79
100000	1.07	1.23	1.39	1.60
150000	0.91	1.05	1.19	1.37

B. 10000 Miles

Vessel Size	Port Days 4	7	10	14
10000	$7.45	$8.06	$8.67	$9.49
20000	4.75	5.14	5.53	6.05
40000	2.99	3.24	3.49	3.82
60000	2.49	2.70	2.91	3.19
80000	2.16	2.34	2.52	2.76
100000	1.94	2.10	2.26	2.47
150000	1.64	1.78	1.92	2.11

C. 15000 Miles

Vessel Size	Port Days 4	7	10	14
10000	$10.98	$11.61	$12.23	$13.06
20000	6.94	7.34	7.74	8.27
40000	4.36	4.61	4.86	5.20
60000	3.62	3.84	4.05	4.33
80000	3.14	3.32	3.50	3.74
100000	2.82	2.98	3.14	3.36
150000	2.38	2.52	2.66	2.85

D. 25000 Miles

Vessel Size	Port Days 4	7	10	14
10000	$18.48	$19.13	$19.79	$20.66
20000	11.51	11.92	12.33	12.87
40000	7.17	7.43	7.68	8.02
60000	5.95	6.16	6.38	6.66
80000	5.14	5.33	5.51	5.76
100000	4.61	4.77	4.94	5.16
150000	3.89	4.03	4.17	4.36

Source: T.D. Heaver, *The Economics of Vessel Size*, National Harbours Board, 1968.

trend in the next decade will continue toward larger average ship size as older smaller vessels are replaced but the size of new vessels will probably not increase very much.

A particularly important variant on the technology of greater size is the adoption of large vessels for use in Arctic ice conditions. There are two possibilities under investigation. The first is the Manhattan type vessel which is testing the feasibility of ice strengthened surface vessels and the power requirements for movement through ice. The other possibility is large submarine tankers that would sail under the ice. This idea may be pursued more vigourously should the surface vessel concept prove either technically or economically unfeasible. If either concept can be developed successfully the development of the Canadian Arctic frontier could begin to become a reality by 1980.

Another area of rapidly changing shipping technology is the container ship and its variants for handling general cargo of all types. It is anticipated that container vessels will capture a major portion of world general cargo trade over the next decade. One source(4) estimates that by 1980, 630 million tons of cargo will be carried in container ships. This compares to a total world general cargo of 400 million tons in 1966. Another example of the expansion of containerized traffic is the number of vessels in operation. In September 1968 there were 50 vessels in operation and by 1970 about 300 container vessels will be in service.

Developments of other types of container vessels are also progressing and will be operational in a few years. The first type with the greatest immediate potential is the roll-on roll-off vessel where containers are rolled on and off ships rather than being lifted. Other variations are barge carrying ships and lighter aboard ship (LASH) vessels. Both vessels carry containers and are designed for areas where ports are not well developed or for services where only small tonnages are off-loaded at a number of ports. They can also be used where inland waterways are available such as the Rhine River in Europe which is too shallow for large vessels but excellent for barges. In either case the mother vessel can quickly off-load the lighter or barge without using shore facilities and continue to the next port without delay.

The St. Lawrence River, Great Lakes system is the principal area where Canadians operate large commercial shipping fleets. The Canadian fleet has been largely built over the past 10 years and is more modern and efficient than the American fleet. Unlike ocean shipping, however, the technological and economic improvement of this fleet is constrained by the limits of the St. Lawrence Seaway i.e. about 26 feet draught, 730 feet length and 75 feet beam. Most new bulk-carrying vessels are being built to these dimensions. However, with the realization that greater economies are available with even greater size, there is inevitable pressure to expand the Seaway system to allow the transit of larger vessels. The difficulty here is, of course, that reductions in the variable costs of shipping can only be achieved at enormous fixed capital expense in Seaway facilities. The estimated cost of $1.2 billion to expand the

Seaway system to accommodate 1000-foot vessels would likely far exceed the variable cost savings for new vessels. Despite what is now an unfavourable outlook for expansion of the Seaway the question will arise in the next decade, particularly if present Seaway capacity limits of about 110 million tons per year are reached.

Demand for Shipping

In the chapter on railways it was predicted that rail transport would become more specialized in the carriage of Canada's bulk commodities such as coal, sulphur, potash, and iron ore. It was further speculated that it was these products that face rapidly expanding demand in overseas markets, particularly in Japan and other Pacific countries. As a result movements by water from Canada will be an important segment of world trade for the shipping industry to serve. Furthermore it will be the bulk carrier segment of the shipping fleet that will be affected by Canadian demands.

The obvious question to ponder, in considering the next decade, is whether Canada can rely exclusively on the world fleet for its shipping needs. Barring international catastrophes, the answer to this question is that there should be no trouble in obtaining an adequate supply of the right type of shipping transportation on the world market.

The current situation in world shipping indicates that for some years to come rates are likely to be quite low. Shipbuilding is presently at a high level with scarcely enough shipyard capacity to meet the demand. Furthermore the ships being built are relatively large. At the beginning of 1968 about 47% of bulk carrier tonnage was in vessels over 50,000 tons and 72% of tanker tonnage being built was in ships over 150,000 tons.(5)

The current heavy building program should virtually assure a good world supply of efficient bulk carriers and tankers. By 1970 it is expected 40% of world bulk dry carrier tonnage will be in vessels over 40,000 tons and 50% of tanker tonnage in vessels over 60,000 tons. These proportions will grow larger throughout the 1970's.(6)

Developments in the general cargo trade raise the same questions as outlined for cargo vessels with regard to the necessity of having Canadian vessels. The apparent eagerness of world shipping firms to establish services to and from Canada indicates, at this point, that Canada will not suffer from lack of service by not having its own fleet of vessels. Furthermore, because of the capacity of the vessels to haul cargo and the high capital cost (from $10 million to $35 million) it is unlikely Canadian trade alone could support many vessels. Thus service to Canada is likely to be part of other trades such as U.S.-Europe or U.S.-Japan. Consequently, if Canadian vessels were built they would likely have to compete in world trade in order to sustain an economic operation. Whether this could be done successfully against a highly competitive, possibly over-supplied market and a lower cost world fleet is very doubtful.

The conclusion to be made from this analysis is that Canada will not likely suffer a shortage of vessel supply or a large economic penalty in terms of rates or efficiency by relying on world shipping for its needs. This does not mean that the question of whether Canada should have its own merchant marine will not arise or that there are not other good reasons for having one. It simply indicates that Canada's competitive position as a major exporter of raw materials and manufactured products would not likely be greatly enhanced by reliance on a domestic fleet rather than the world fleet.

Other Marine Transportation Problems

An important federal transportation expenditure is the provision of ferry services within and between the Atlantic Provinces. In 1967 about $30 million was spent on vessel operating subsidies alone. In addition, $27 million was spent for vessels plus supporting harbour development and navigational expenditures.

Expenditures of these magnitudes raise questions of whether the money is being spent in the most efficient way. The Department of Transport is beginning to look at this question with an initial study of Newfoundland transportation. It is almost inevitable that these studies will find areas where change will be beneficial.

In some cases needed changes could be quite drastic such as a complete reorientation of traffic flows to and from Newfoundland from the present rail-ferry-rail system to a complete water voyage from Montreal (or other inland port) direct to Newfoundland and redistribution by truck to inland destinations. Even a complete change of mode for a large portion of goods to and from Newfoundland may not be out of the question. With new large freight carrying aircraft it is conceivable that it would be more economic to serve Newfoundland by air. Such changes, while possibly economically and financially beneficial, will, nevertheless, cause some political problems and require certain transportation policy decisions before they can be implemented.

Government Policy Implications

A number of developments in the shipping field have been outlined that will raise policy issues for the government in the next few years.

Possibly the most important issue (certainly potentially the most costly) will centre around whether or not to develop a Canadian ocean fleet. Many questions will arise in a debate on this subject which have a direct bearing on federal policy. For example, if a fleet were developed, should Canada import ships at lower cost from efficient overseas shipyards or subsidize Canadian shipyards in a major way.

Questions of protecting trade for Canadian vessels would also arise. For example, should foreign aid shipments be restricted to Canadian vessels or should Canada terminate provisions of the Canada Shipping Act giving Commonwealth registered vessels preference in the coasting trade.

An issue that will arise more immediately is the question of toll levels on the St. Lawrence Seaway. This will arise in 1970 and possibly once or twice more in the decade, rather than being settled once and for all. The problem with tolls will be obtaining agreement between the U.S. and Canada on the level of tolls and the related issues of refinancing Seaway debt and forgiving interest payments.

Closely tied to the toll issue will be the question of capital expenditures on the seaway and decisions may have to be reached in the 1970's as to whether or not to expand the size of locks in order to permit the use of larger vessels.

The possibility of regular shipping through Arctic waters raises a number of policy problems for the government. The decision to establish jurisdiction over large areas of Arctic waters in order to control the dangers of pollution also has implications for the provision of facilities for shipping. For example the extent to which Canada will provide aid to vessels that might encounter difficulties in the ice will have to be determined. Finally there may be necessary decisions related to the provision of navigational aids, harbours and dredging in northern waters, all of which are potentially very costly.

Finally, federal policy will have to be established for maritime transportation in the Atlantic Provinces. Many of the services now being provided cannot be easily abandoned; indeed they are part of national policy and there will be no question of whether or not to maintain service and subsidize it. The issue is really how effectively the services are maintained at present and how should they be changed to improve efficiency while fulfilling federal commitments to the Atlantic Provinces.

CHAPTER V

HIGHWAY TRANSPORTATION

Highway transportation dominates the field of passenger travel in Canada. It is estimated that 92% of all travel in Canada takes place on highways: 89% in automobiles, and 3% in buses. In absolute figures, in 1967 about 100 billion passenger-miles were in private automobiles and about 3 billion were in buses (TABLE II).

Highway transportation for freight is only fourth in importance in terms of ton miles after rail, water and oil pipelines, with about an 8.5% share of the market (TABLE IX). In 1967 about 22 billion ton miles of freight transportation was on highways; double the level of a decade earlier.

The general outlook for the development of the highway system and the commercial development connected with highways can only be viewed as optimistic. Already highways are by far the most important transportation investment in Canada and this will likely continue through the next decade. In 1966 about $1.2 billion was spent on highways, roads and urban streets in Canada. In addition, $2.8 billion was invested in motor vehicle equipment of all kinds, making a total expenditure on capital plant of $4 billion. In comparison rail investment in 1966 totalled $242 million and air about $75 million.

Highway Passenger Travel

In forecasting developments in highway transportation the most vital factor is private travel in automobiles. It is the largest passenger travel segment and the most difficult to measure in that it is private and not subject to the analysis of public carriers who charge specific prices, count customers and often record distances travelled.

It is obvious however, from simple observations, and estimates calculated by D.B.S. that vast amounts of transportation service is performed by automobiles. Moreover, it seems equally obvious that this will continue to be the case on an even larger scale in the next decade. The growth in highway passenger miles has shown a constant growth rate of about 11% per year. There is little evidence that similar growth will not continue throughout the next decade. If so automobile passenger miles would reach 190 billion per year by 1980. (Graph 6)

By choice, people have made it amply clear that for intercity travel, over distances of up to 500 miles, they have a strong preference for automobiles. This is not a surprising preference given the convenience, flexibility and perceived inexpensiveness of a car compared to buses and trains. These advantages are particularly compelling when two or more people are travelling or for family travel. On the other hand, these advantages may be less evident in or

TABLE IX

Total Freight Ton Miles in Canada
and Percentage of Market of Transport Modes 1960-68

	Trucks Intercity and Local Operation			Commercial Services			Pipelines		
	Fire Hire Common and Contract	Private and Farm Operation	Total	Rail	Water	Air	Oil Gathering and Trunk Systems	Gas Transport Systems	Total All Modes
	Billions of Ton Miles								
1960	9.98	5.62	15.60	65.45	56.90	.04	20.44	6.44	164.84
1961	11.72	6.27	17.99	65.83	61.43	.05	25.09	9.31	179.70
1962	12.04	6.40	18.44	67.94	70.24	.05	28.37	11.71	196.75
1963	11.97	6.67	18.64	75.80	70.90	.06	29.95	13.23	208.58
1964	12.55	6.94	19.49	86.97	78.02	.08	32.52	15.31	232.39
1965	13.10	7.21	20.31	89.02	76.11	.09	34.72	16.95	237.20
1966	13.54	7.59	21.13	96.83	82.68	.13	38.80	17.94	257.51
1967	14.01	7.71	21.72	94.10	74.64	.13	43.08	19.21	252.88
1968	-	-	-	95.10	-	.17	47.22	22.04	-
	Per Cent Share of Market								
1960	6.1	3.4	9.5	39.7	34.5	-	12.4	3.9	100.0
1961	6.5	3.5	10.0	36.6	34.2	-	14.0	5.2	100.0
1962	6.1	3.3	9.4	34.5	35.7	-	14.4	6.0	100.0
1963	5.7	3.2	8.9	36.3	34.0	-	14.4	6.3	100.0
1964	5.4	3.0	8.4	37.4	33.6	-	14.0	6.6	100.0
1965	5.5	3.0	8.5	37.5	32.1	-	14.6	7.1	100.0
1966	5.3	2.9	8.2	37.6	32.1	.1	15.1	7.0	100.0
1967	5.5	3.0	8.5	37.2	29.5	.1	17.0	7.6	100.0

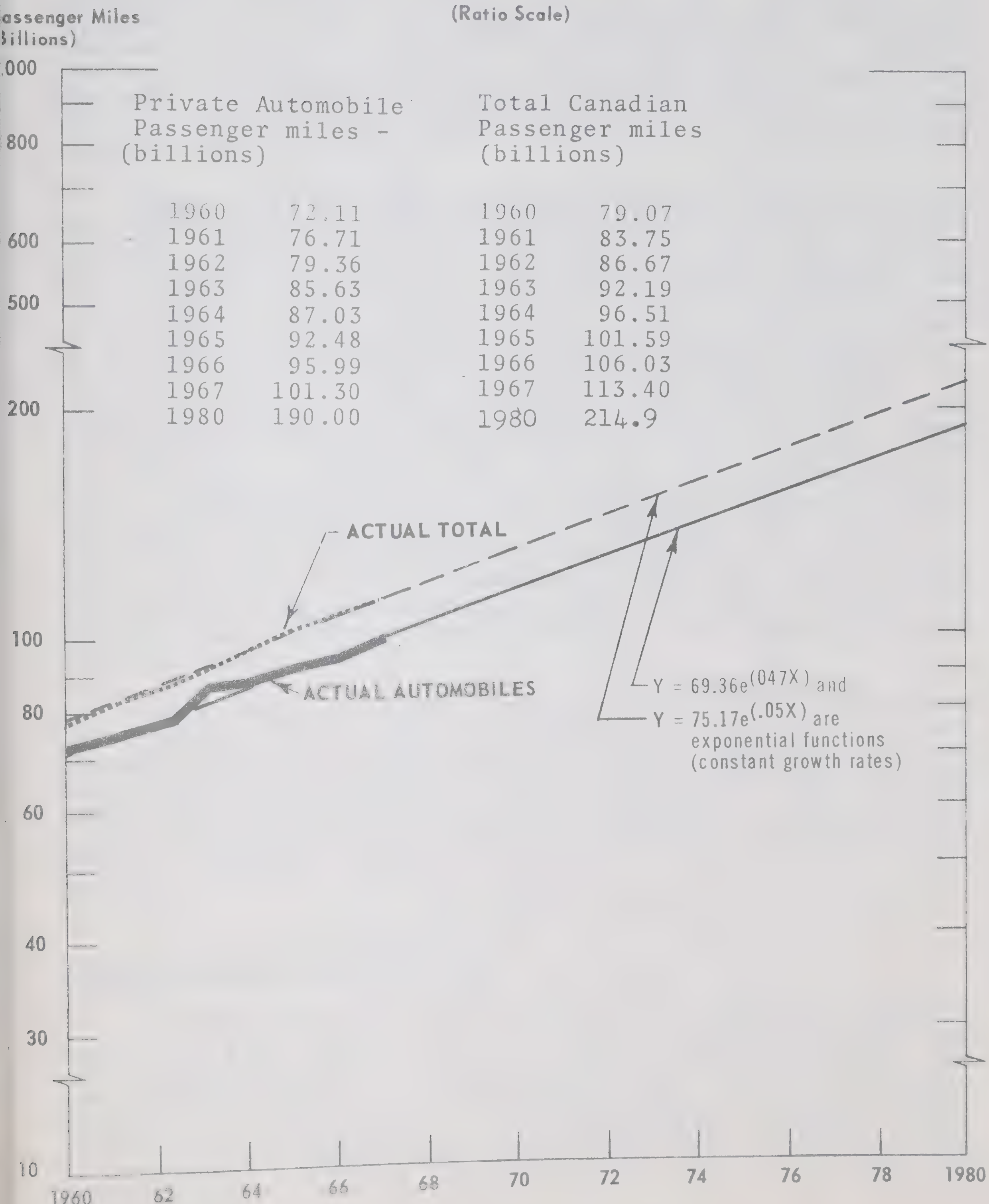
Source: Dominion Bureau of Statistics, Transportation Service Bulletin, Issue 2, March 1970.

GRAPH 6

PASSENGER MILES IN PRIVATE AUTOMOBILES 1960 - 1967

WITH A PROJECTION TO 1980

(Ratio Scale)



Private Automobile Passenger miles - (billions)		Total Canadian Passenger miles (billions)	
1960	72.11	1960	79.07
1961	76.71	1961	83.75
1962	79.36	1962	86.67
1963	85.63	1963	92.19
1964	87.03	1964	96.51
1965	92.48	1965	101.59
1966	95.99	1966	106.03
1967	101.30	1967	113.40
1980	190.00	1980	214.9

near urban areas when congestion becomes a serious problem. This aspect is discussed in Chapter VII.

As with most forms of personal travel, highway travel is a product of increasing standards of living. As incomes rise more people purchase at least one automobile and even two or three may be owned by the more affluent. In the decade between 1957 and 1967 the number of passenger cars per household in Canada rose from .85 to 1.1. Similarly the number of households owning two or more cars rose from 235,000 to 754,000 and total passenger cars registered increased from 3.4 million to 5.7 million (TABLE X). Another factor in addition to vehicle numbers is vehicle usage which has been increasing substantially in recent years. In 1968 each car in Canada was driven an average of 900 miles further than in 1963 (TABLE XI).

There does not appear to be any factor that will change the basic trend of automobile usage during the next decade. Greater affluence will mean more cars will be used and there will be more uses for them. Vacations, summer cottages and an expanding array of leisure activities will encourage people to travel more often in their cars. A point is likely to be reached, however, where the actual growth in numbers of cars will slow to a level related to population growth. A study by the Ontario Highways Department of a few years ago foresaw the number of cars levelling at about one for every 2.5 persons. Currently in Ontario, this ratio is one for each 3.1 persons, and in Canada one for each 3.6 persons. Using population growth at rates similar to those assumed by the Economic Council of Canada and a one car to 2.7 person ratio in 1980, the number of cars in Canada would rise to about 9.4 million from 5.8 million in 1967 (1). Using simple straight line regression over the past 10 years yields an estimate only slightly lower of about 8.8 million automobiles by 1980. (Graph 7).

There will, of course, continue to be a role for highway bus transportation. With the possible discontinuance of long distance trains, busses will be the only commercial surface long distance mode of transport. Consequently busses will likely continue to grow as a passenger mode at least as fast as in the 1960's and by 1980 may account for about 5.36 billion passenger miles as compared to 2.32 billion in 1967. (Graph 8)

Highway Freight Transportation

The carriage of freight by truck has developed rapidly over the past decade, a fact that is partially obscured by TABLE IX which shows a fairly consistent market share in the past three years. A consideration of the type of traffic carried on trucks and the developments in other modes, particularly pipelines, and railroads reveals that maintaining a constant 6.5% market share is a considerable achievement.

TABLE X

CAR OWNERSHIP BY HOUSEHOLDS IN CANADA

Year	Total Number of Cars	Cars per Household	Households with 2 or more cars
1967	5,772,000	1.1	754,000
1966	5,500,000	1.1	698,000
1965	5,279,000	1.1	604,000
1964	5,038,000	1.1	571,000
1963	4,789,000	1.0	479,000
1962	4,531,000	1.0	428,000
1961	4,326,000	1.02	362,000
1960	4,104,000	.97	324,000
1959	3,886,000	.94	309,000
1958	3,631,000	.90	280,000
1957	3,429,000	.87	235,000

Source: *Facts and Figures of the Automotive Industry*, Motor Vehicle Manufacturers' Association, Various Issues.

TABLE XI

ESTIMATED MILES TRAVELLED
PER AUTOMOBILE
1963-1967

Year	Vehicle Miles	Number of Vehicles	Miles per Vehicle
	Millions	Thousands	
1967	65,704	5,772	11,400
1966	62,588	5,500	11,370
1965	58,299	5,279	11,100
1964	53,673	5,038	10,650
1963	50,453	4,789	10,500

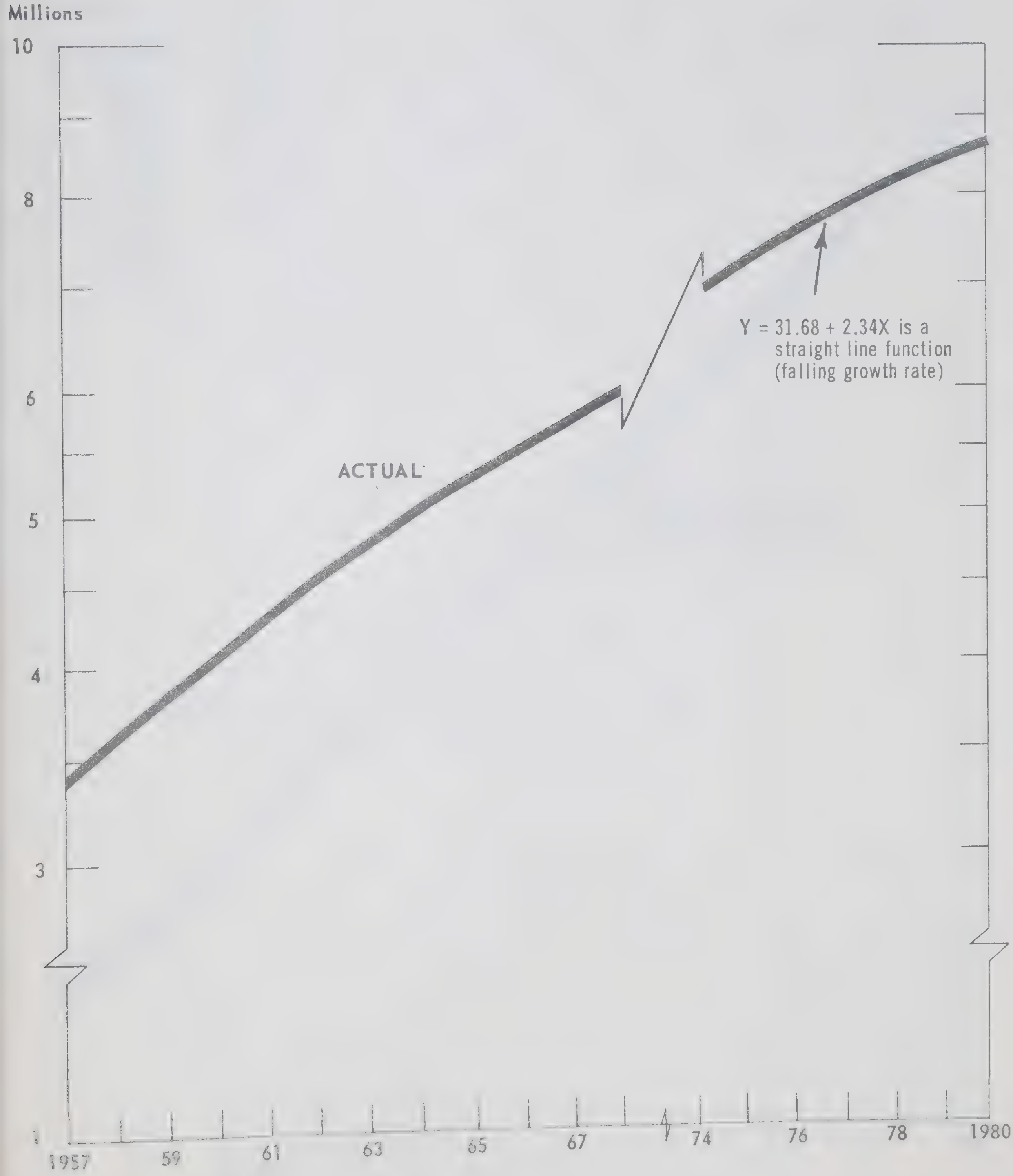
Source: Facts and Figures of the Automotive Industry, Motor Vehicle Manufacturers' Association, Various Issues.

GRAPH 7

CANADIAN AUTOMOBILE REGISTRATIONS 1957 - 1967

WITH A PROJECTION TO 1980

(Ratio Scale)

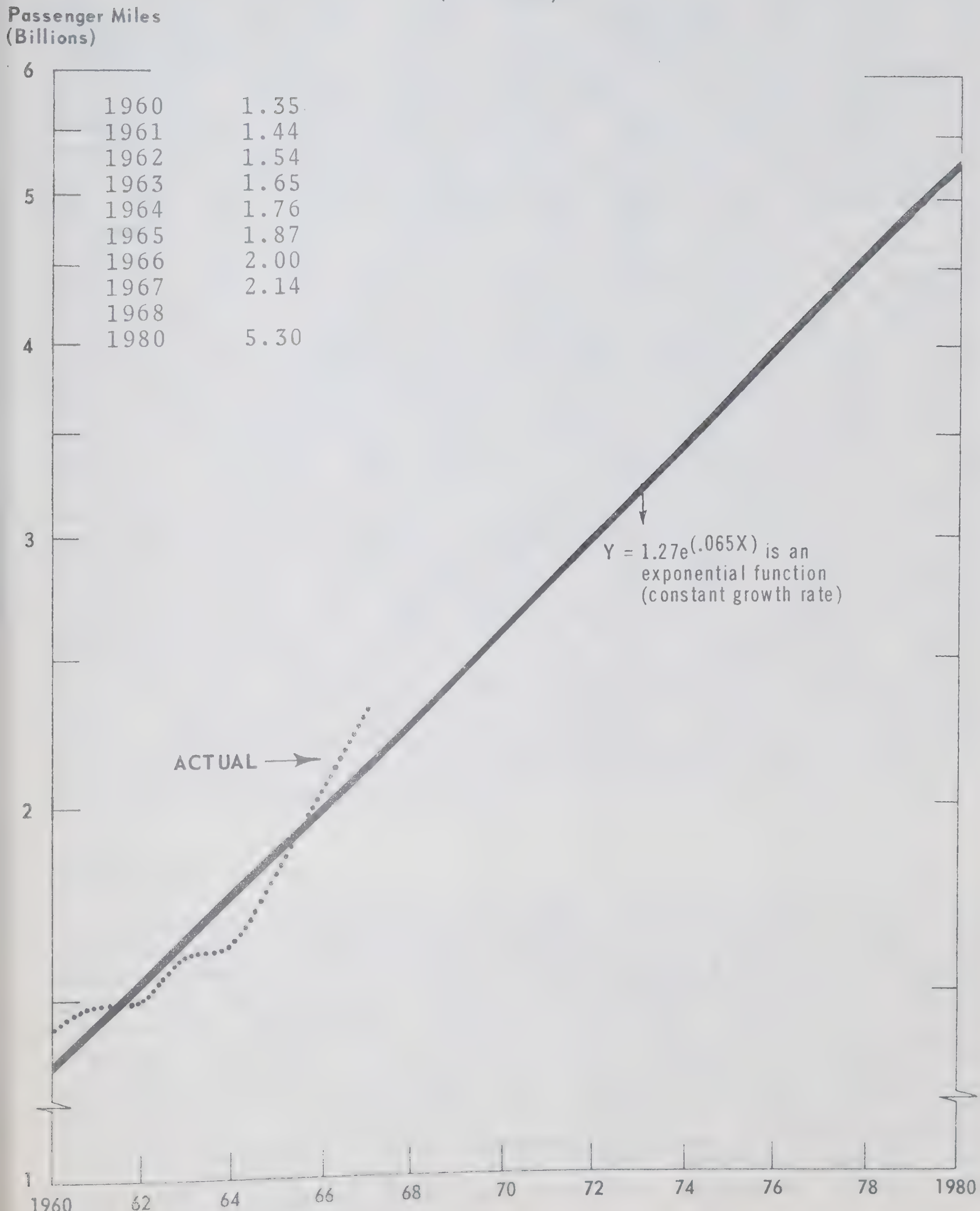


GRAPH 8

BUS PASSENGER MILES 1960 - 1967

WITH A PROJECTION TO 1980

(Ratio Scale)



Most commercial trucking business consists of hauling manufactured products in relatively small quantities. Furthermore, the basic transportation unit, the trailer has a low capacity compared to railway box cars and especially pipelines. Despite the relatively light non-bulk traffic and small transport units, trucks actually added about 4 billion ton miles to their total volume between 1963 and 1967, a 22% increase (TABLE IX).

The future of truck freight carriage is closely tied to the overall growth of the Canadian economy. In the United States studies have shown that intercity ton miles of transportation are almost perfectly correlated with GNP and Industrial Production.(2) At the same time, truck ton miles have grown slightly faster than GNP as this mode captured a larger share of the total market. This has occurred in Canada as well although trucking is a much smaller portion of the total transport market than in the U.S. This reflects the fact that large tonnages of heavy bulk commodities shipped over long distances are more important in the Canadian transport system. This comparative difference between the U.S. and Canada is not likely to change significantly in the next decade, although the further development of secondary manufacturing industry in Canada should provide trucking with continued growth at much the same rates of increase as in the United States. One factor that could possibly encourage a faster growth is the fact that the highway system has not been as well developed as in the U.S. This may have acted to inhibit truck growth in the past but recent completion of the Trans Canada Highway and upgrading of highways in areas such as the Atlantic Provinces may contribute to stronger growth rates in trucking in the future. These trends have not yet appeared in the DBS data on trucking and projections based on the past yield growth rates of about 4% per year (Graph 9). There are some weaknesses in the DBS data however and it is likely that this projected estimate is too low. Ton mile growth in the U.S. is estimated at 6% per year. Given Canadian circumstances with regard to highway upgrading and industrial diversification the 6% growth rate would probably be a better one. This would result in a forecast of about 50 billion ton miles by 1980 compared to 38.7 at the lower 4% rate.

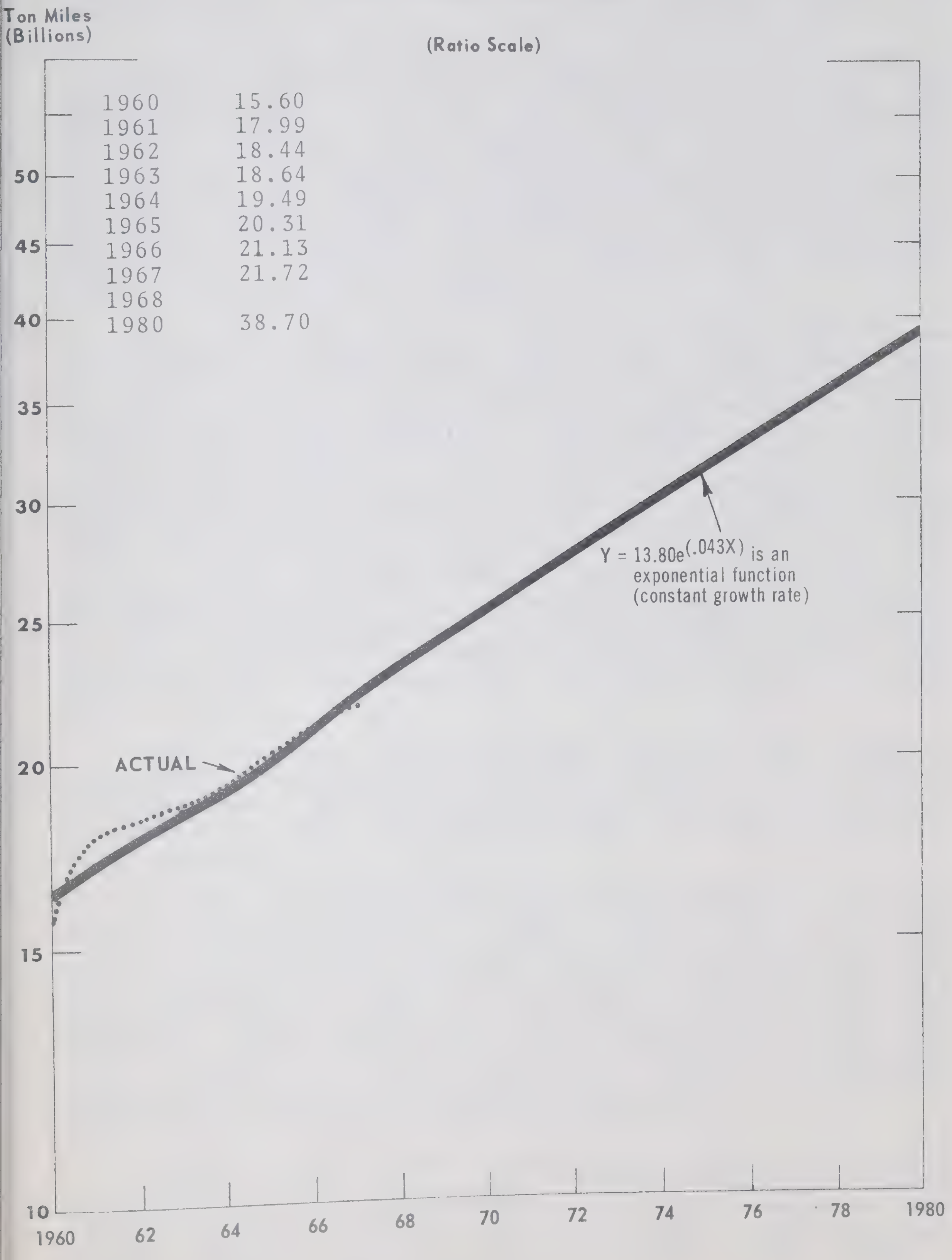
Technology

Highway technology in the next decade is unlikely to be revolutionary, despite the frequent glowing reports that are heard about automatic highway guide systems or the impending demise of the wheel in favour of air cushion vehicles. Given a universal nationwide system in which governments have invested billions of dollars (and are continuing to spend billions of dollars each year), it is unlikely freeways and highways will be replaced or taken over by driverless vehicles and guideways for air cushion vehicles. The enormous expense of the undertaking is one obstacle as well as the question of whether significant benefits could, in fact, be gained in Canada over the present system of intercity highway travel.

GRAPH 9

TRUCK TON MILES 1960 - 1967

WITH A PROJECTION TO 1980



This is not to say that significant technological development will not occur in the next decade, even if automated highways and wheel-less vehicles are not prevalent in 1980. Probably the most significant technological changes in motor vehicles will be the advent of new motive power. Car manufacturers are actively experimenting with electric cars and turbine-powered cars and it seems likely that an economical vehicle using either of these forms of power can be developed.

One factor giving impetus to the search for a replacement to the internal combustion engine is the pollution problem. One of the major sources of air pollution in North America is the automobile and, as regulations are passed to control exhaust emissions, the pressure will grow to have a low pollutant engine powered by electricity or turbines. There is the alternative, of course, that the pollutants from present engines can be successfully and economically controlled by new devices and, therefore, relieving pressure for an alternative.

The main technological thrust for trucking and the bus industry will be toward larger units. One development that is already well established in the U.S. and Western Canada is larger units and larger hauls with double or triple bottom truck-trailers. This involves a tractor pulling two or three trailer units instead of the one large unit that is common in Canada today. The individual trailers are smaller but the overall payload is greater. The length of this combined unit using two 27-foot trailers would be about 65 feet the maximum length allowed on most highways in the U.S. and Canada. The use of these smaller units improves efficiency of distribution in urban areas and obviously improves efficiency of over-the-road operations in that larger payloads are carried. The trucking industry appears to view this innovation as the single most important development in the next few years.

Some problems that may arise in trucking concern provincial regulations regarding weight and length. Efficient use of double bottom trailers could be restricted if provinces fail to adopt standard regulations regarding their operation in each province.

As with automobiles there is also a possibility that new motive power may be used in trucks. This would likely be turbine power since it has the potential to meet the high power requirements of trucking. Electric power does not have this potential at the present time. Experiments are presently being carried out with turbine-powered trucks but so far the results would not justify widespread use. The main drawback is that efficiency can only be maintained at high speeds. When city driving or slower speeds are required fuel consumption becomes prohibitively high.

Finally there are possibilities for operational innovation that could have marked affects on truck transportation. One example is the possible assignment of certain highway lanes to exclusive truck usage on high density routes. This could greatly improve the overall safety of highways for automobiles.

Government Policy Implications

Provincial governments in Canada have primary responsibility for the development of highway systems. Regulatory control of the trucking industry was assigned to the provinces in 1954 although the federal government still holds jurisdiction in this field. Because of this, problems in this field will be difficult for the federal government to tackle except, perhaps, to offer financial assistance in particular instances. For example, the federal government will almost certainly be involved in highway planning and assistance in areas such as the Atlantic Provinces.

In the short term, the federal government faces the problem of establishing its own regulatory procedures over the interprovincial trucking industry. A number of federal-provincial problems exist because of the previous assignment of this duty to the provinces. As a result the provinces are acting cautiously in relinquishing this authority but the federal government has decided that rational economic development of the industry will be facilitated by federal regulation.

Other areas of federal concern are pollution and safety problems of motor vehicles. Definition of realistic regulations and standards in this field will be difficult and possibly controversial. There may also be grounds for federal initiatives in research and development into safer, quieter and cleaner motor vehicles.

Finally, there will likely be pressure for the federal government to set national objectives for the Canadian highway system in terms of resources committed and in terms of nationwide highway standards. The Trans-Canada Highway Program is an example of such a national objective.

CHAPTER VI

PIPELINE TRANSPORTATION

Liquid Pipelines

The carriage of oil and gas by pipelines has expanded rapidly during the past decade to become one of the major transport modes in Canada. In 1967 pipelines accounted for about 62 billion ton miles of transportation or 25% of total ton miles performed in Canada, up from 22% in 1966 (Table IX) and virtually nil in 1956. This impressive growth has not been at the expense of other carriers but reflects the addition of an important new transport means which permitted exploitation of Canada's oil and gas resources. No other transport mode could have done the job as economically.

A brief look at the future prospects for energy, and particularly oil and gas, indicates continuing growth for pipeline transportation. By 1980 the domestic Canadian demand for oil will rise to 700 million barrels from 440 million barrels in 1966. Growth in demand for natural gas will be even faster, from 700 billion cu. ft. in 1966 to 1.5 trillion cu. ft. in 1980.(1)

It is difficult to predict how these demand forecasts will translate into ton miles but Graphs 10 and 11 give a rough idea of pipeline volume by 1980, based on trends in recent years. The best trend line for oil ton miles (Graph 10) is a straight line and projected to 1980 gives of forecast at 83.10 domestic ton miles. For gas pipelines the trend line (Graph 11) indicates a marked drop in the growth rate with a forecast of 33.1 billion ton miles. This forecast, based as it is on past trends would appear conservative when the overall market for gas is considered.

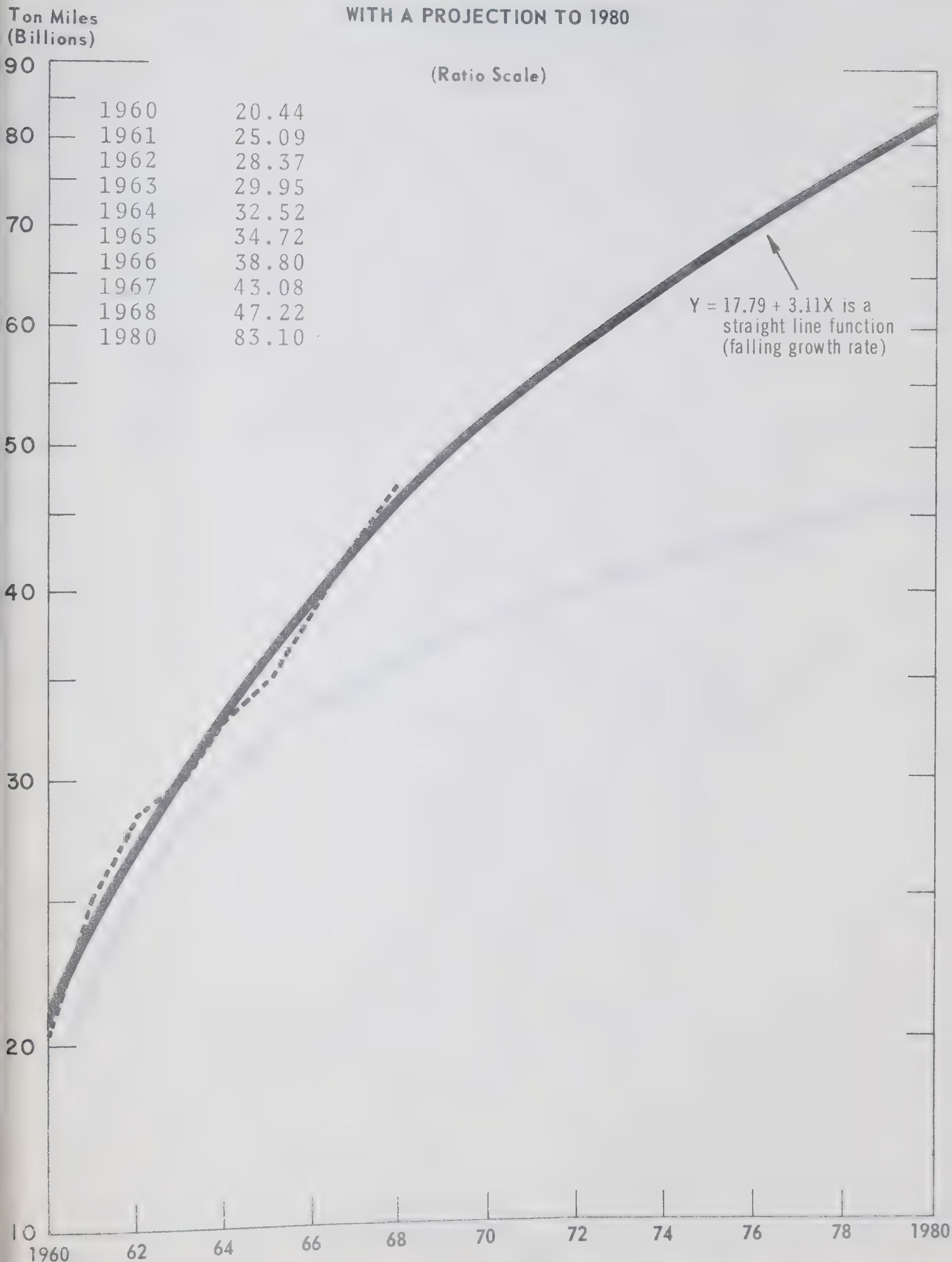
The U.S. demand for oil and gas also affects the demand for pipeline transport in Canada. A recent survey of energy requirements in the United States(2) indicates that the North-Central U.S. region will experience one of the greatest increases in demand for oil and gas between now and 1980. It is predicted the market will grow from 1.3 billion barrels in 1966 to 2.3 billion barrels in 1980. In 1966 Canada supplied about 68 million barrels to this market and in 1967 about 83 million. This high growth market is one in which Canada might logically expect to obtain a growing share. At the present time, however, unknowns such as American policy toward imports of oil and toward development of new domestic sources such as in Alaska tend to cloud present expectations in these markets. If the United States decided to restrict Canadian oil imports the growth of pipeline transport in Canada would clearly be restricted. On the other hand, if Alaska oil were to be directed to the North Central U.S. market a great expansion of pipelines through Canada would be a strong possibility.

Natural gas, which now flows to the U.S. Western States in large quantities is not similarly threatened by U.S. import restrictions. Of total Canadian sales of about one trillion cubic feet in 1966, about 431 billion cubic feet were exported to the U.S. Canada will likely continue this heavy export of

GRAPH 10

OIL PIPELINE TON MILES 1960 - 1968

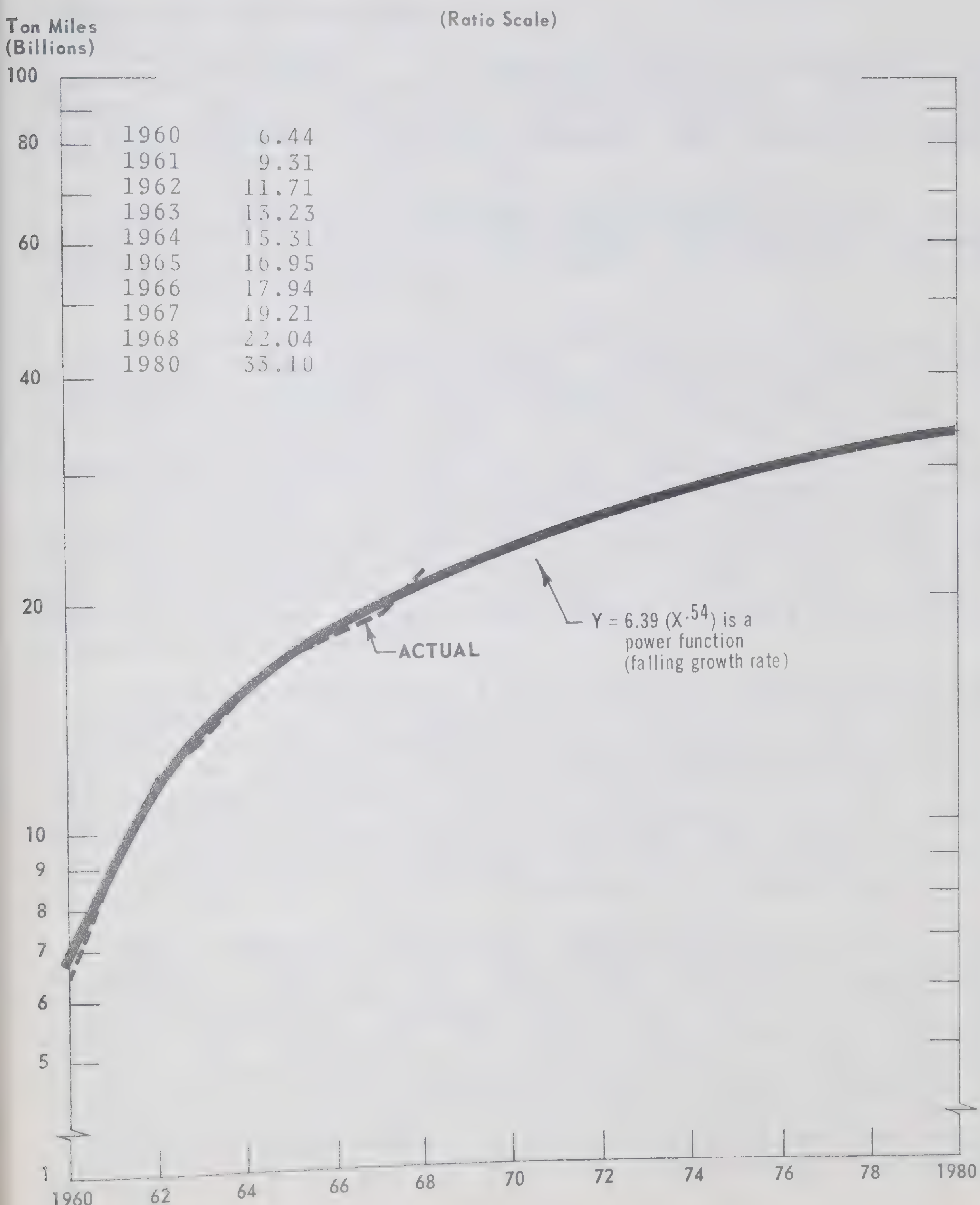
WITH A PROJECTION TO 1980



GRAPH 11

GAS PIPELINE TON MILES 1960 - 1968

WITH A PROJECTION TO 1980



natural gas energy to U.S. markets and in addition will probably share in the growth of these markets.

It seems clear that pipelines will continue to expand over the next decade. It seems equally clear that future expansion, financing and regulation of pipeline networks probably will not raise difficult governmental problems. The industry has a record of being regulated and expanded in an orderly fashion and there are no apparent reasons why this should not continue in future.

Slurry or Solids Pipelines

The development of the pipeline for the transport of solid commodities in large volumes is a real possibility in the next decade. Canada is one area of the world probably ideally suited for such development with long distances and plentiful natural resources suitable to pipelining.

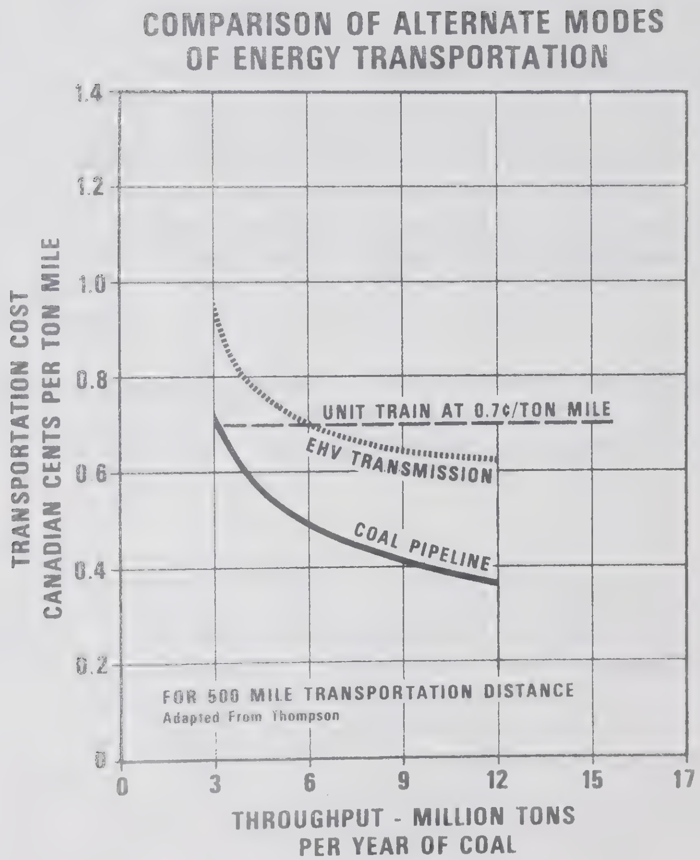
Expert opinion(3) indicates that pipelines will have their greatest advantage where no established transportation already exists, where volumes are very high in one direction, and where long distances are involved.

The actual physical ability to move goods in slurry has been proven to be an economic venture. Iron ore concentrate, coal, limestone and gilsonite are all presently being pipelined. Coal is currently the most important product transported by pipeline. A 273 mile line is being built in Arizona that will have a capacity of 4.8 million tons per year. When completed it will be the longest distance, highest volume slurry pipeline in operation in North America and probably the world. As yet no truly long distance pipeline, i.e., 500 miles or more, has been constructed for solids, although a 700 mile line for sulphur from Alberta to the British Columbia coast was planned in 1968 by Shell Canada. However reduction in rail rates appears to have sidelined these plans for the time being.

Present day economics of slurry pipelines indicate this mode of transport will be restricted to special situations where conditions are particularly favourable. Tonnages over a route have to be in excess of three million tons per year before any real advantage of pipeline over rail is shown in terms of total transportation costs. As Graph 12 illustrates, at three million tons per annum rail and pipeline total costs are both about .7 cents per ton mile. As tonnages rise beyond three million tons, pipeline costs per ton mile fall substantially below rail.

Clearly where rail lines are already in place it will be hard to justify a large outlay for a solids pipeline. Further technological advances, of course, may improve the competitive position of pipeline transport but this could be offset by greater rail efficiency. In fact, it is suggested that even today the actual out of pocket costs on some bulk hauls on rail is as low as .35 cents or .4 cents per ton mile. If this is so the railways now have additional leeway to compete with possible pipeline cost improvements. In fact, in at least one case actual rates for a unit train over 400 miles are as low as .4 cents per ton mile.

GRAPH 12



SOURCE: E.J. Wasp and W.L.J. Fallow, Some Aspects of Slurry Pipeline Economics and Application.

Transportation Research Forum, May 1969.

A final consideration is to note that per ton mile costs of .5 cents are already very low and it is not likely that new innovations either in railroading or pipelining can lower this cost significantly downward in the next decade. A 25% reduction in costs of .5 cents per ton mile will only save 60 cents per ton in a 500 mile haul.

Under these economic conditions it can be foreseen that pipelines may find a place in remote resource developments of the north where transport services are now largely non-existent. They may also have a limited role in southern Canadian areas as a means of competition to the established modes of transport. This could occur if existing modes are unwilling to compete through lower rates. The proposed sulphur pipeline from Alberta could be an example of such a competitive development, if the line is ultimately built.

Recent rail rate decreases of $1.50 per ton for sulphur have been instituted and if unit trains are used it is speculated a further $2.00 per ton reduction in rail rates would be possible. This would bring rates down to about .7 cents per ton mile. At volumes of one to two million tons per year it is unlikely a pipeline could compete with rates at this level. However, the use of oil as the pipeline medium for the sulphur would offset this relationship since the oil itself has to be transported to the same destination. This could make the pipeline a justifiable proposition whereas the transport of sulphur alone probably would not justify the line.

Finally, pipelines may have a role where movement of large volumes are constrained by capacity limitations of railways. In this case it may be cheaper to undertake a pipeline rather than a new railway.

Capsule Pipelines

Capsule pipeline systems are currently being investigated and the actual movement of a capsule over a distance of about 100 miles has been accomplished. However, an economically feasible system is not an immediate prospect and it will be well into the 1970's before any really viable system is found, if one is found at all. The ultimate implication of capsule pipelining on a large scale is that they could have the potential for carrying the small package traffic that at present is a costly problem to railways and truckers. Such a development could bring important efficiency improvements in handling this traffic.

The obvious policy question of either slurry or capsule pipeline development is who should own and develop pipelines; present pipeline companies, those now moving the commodities that would be transported, or other transportation companies now engaged in established forms of carriage. While Canada allows intermodal ownership of transportation it is an important question as to how far this should be allowed to develop. It is particularly pertinent in the pipeline case since pipelines are so rarely owned by other transportation companies nor are pipeline companies engaged in other forms of transport.

CHAPTER VII

URBAN TRANSPORTATION

Urban transportation development over the next decade will be shaped by influences much different from those that will shape most commercial transport undertakings. Urban transportation is really a submarket of the overall transportation market, but localized within the urbanized areas of Canada. Because of this urban orientation and because urbanization is one of the most dynamic features of Canadian society, it follows that urban transportation will be subject to the resulting social pressures and changes that are features of urban society. In other words economic factors, while important in urban transportation, will not be the prime influence on future development. Rather, development is much more likely to be shaped by social factors within a broad view of expectations of what Canada's urban centres should become. When seen in this light any forecast of future development is extremely difficult. Indeed it is impossible because the developments will almost certainly vary from city to city depending on geography, climate, size, wealth and the tastes of the citizens.

One feature of urban transportation over the past 20 years illustrates the powerful force of social factors on urban transport demand. There is little doubt that total transport demand in the urban areas has grown remarkably since World War II. Cities have grown rapidly and rising incomes have generated demand for cars and suburban housing. Strong preference for single family housing and the personal freedom of the private automobile are social and economic factors that have led to a rapid decline in public transit usage. Between 1946 and 1960 urban transit passengers fell from 1.5 billion per year to less than 1.0 billion. Since 1960 the decline has halted and a slight growth to 1.1 billion passengers in 1967 has been recorded.(1) Most of this growth however is due to the opening of the Montreal Metro system in 1966. It is clear from this trend that public transit, as a means of passenger travel in urban areas has become much less important in the past 20 years. Table XII brings this into even sharper focus by showing the overpowering dominance of the automobile, which since 1964 has accounted for an estimated 97% of all urban passenger miles, assuming that ratios studied in the United States apply in Canadian urban areas as well. It is seen that even though the downward trend in urban transit passenger miles was reversed during the 1960's the overall dominance of the automobile increased.

Demand for Urban Transportation

It can be said with considerable confidence that total demand for transportation of goods and people in urban centres will grow continually over the next decade. Continued urbanization and growing affluence are both dynamic factors leading to greater transportation requirements in the cities.

The Economic Council, in its 4th Annual Review, estimated that by 1980 about one-third of Canada's population would live in the three metropolitan areas of Montreal, Toronto and Vancouver. For all of Canada the Council estimated that by 1980 over 60% of Canada's population would live in cities with 100,000 or more

TABLE XII

Per Cent of Urban Passenger Miles
on Urban Public Transport and Automobiles 1958-1967

	Automobiles	Bus	Other Urban Public Transit	Total
1958	95.2	2.7	2.0	100.0
1959	95.7	2.6	1.7	100.0
1960	96.1	2.5	1.4	100.0
1961	96.5	2.3	1.2	100.0
1962	96.6	2.2	1.2	100.0
1963	96.9	2.1	1.0	100.0
1964	97.1	2.0	.9	100.0
1965	97.1	2.0	.9	100.0
1966	97. 1	2.0	.9	100.0
1967	97.1	1.9	1.0	100.0

Source: Dominion Bureau of Statistics, Transportation Service Bulletin, Issue 1, November 1969.

population. Numbers alone, therefore, will result in greater urban transport demands.

A number of other features of urban transportation help to demonstrate the magnitude and dimensions of this activity. In Chapter V it was stated that about 95 billion passenger miles were travelled on highways in Canada in 1968 and that about 91 billion passenger miles were by automobile. While estimation is difficult it has been stated that up to 50% of this automobile passenger travel takes place within urban areas. In addition public transit carries large numbers of people in urban areas. In 1967 slightly over one billion individual passenger fares were collected, although no figures are available as to passenger miles. However, as Table II indicates, DBS estimated that in 1967 slightly over one billion passenger miles were on urban public transport. This is possibly a conservative estimate in that it indicates each passenger travelled only one mile. An actual passenger mile figure of two or three billion for 1967 would probably not be unreasonable.

A recent urban transportation survey estimated that trucks carried 354 million tons of freight within urban areas in 1967 compared to a total intercity movement by trucks, trains and ships of about 700 million tons. Finally a recent study completed for the Department of Transport concluded that between 40% and 50% of the total cost of urban transport is accounted for by trucking. The inference of all this data is that the transportation of freight within urban areas may be of equal importance to the transportation of people. Recent refinements to DBS statistics on truck transport indicate that in 1967 about 3.8 billion ton miles out of a total of 21.1 billion ton miles of truck transport was performed in local urban and rural service. The statistics are not completely reliable but it does indicate that a large portion of total truck freight haulage is performed in urban areas.

In Chapter V it was stated that the automobile would probably remain the dominant mode of personal transportation in the next decade. The conclusion applies to the bulk of urban travel as well as to intercity travel. Rising affluence and more complex urban areas will encourage more travel and emphasize a need for mobility. In certain aspects, on the other hand, there are possibilities for the car to become less dominant. This possible change centres around the journey to and from work and the development of new technology that may make commuters regular public transit riders rather than car drivers.

Technology in Urban Transportation

A number of new transit systems are currently being developed and demonstrated that could have a significant impact on the attractiveness of public transit for urban commuters. These systems are being designed for urban centres of all sizes and hence are not limited to high capacity techniques such as the subway train. In fact most of the new systems being discussed are complementary to high capacity systems.

The main feature of the new transit systems being investigated is the apparent objective to serve demand as it now exists in low density suburbs and to do so efficiently and

conveniently from the rider's point of view. One of the most frequently mentioned systems is the Dial-A-Bus. This system proposes to integrate computers and vehicles to give personal door to door service. The customer would phone the computer to say he wished to be picked up, and a vehicle would be automatically selected and dispatched to the pickup location. The vehicle itself would be smaller than an ordinary bus and would likely drop people at a transit or subway terminal.

Other experiments in improved transit service involve tracked driverless vehicles that are dispatched by computers over a guideway network. The vehicles would be small, holding six or eight people. Hence the system has been dubbed "personal rapid transit". The rider would punch his destination into a keyboard in the vehicle. A central computer would then dispatch the car non-stop to the destination. The drawback so far has been the development of electronic control devices capable of this type of task. However, if such a system became feasible it would be an attractive alternative to the private automobile.

Another automated system that may be implemented at least in one city is the "Sky Bus". This is a fully automated form of mass transit for higher density areas than either Dial-A-Bus or personal rapid transit. In fact it is an adoption of the standard elevated railway. However, it operates with rubber tired, driverless vehicles holding about 28 passengers. None of the new systems being conceived are likely to be less costly than current transit and some may well be more costly. Indeed it is probably true to say that low cost is not the most important aim. The real aim is to design systems that improve user acceptance with reasonable cost being an important constraint to that objective.

It is impossible to say which of the new systems will be most successful and which will be implemented in Canada. It is possible they will all have some use in particular situations; the main criteria for adoption being the ability to discourage car use, particularly during rush hours. The extent of their use will depend, of course, on the choices governments make for directing their transportation expenditures. If freeways are built to accommodate the rush-hour traffic it will be hard to use transit to discourage car usage. In any event resources will probably not be adequate to allow both systems to be built.

Government Policy Implications

The problems of administering and operating cities are clearly beyond the jurisdiction of the federal government. Thus any role the federal government has to play in influencing urban development, and in particular transportation, must be based on federal-provincial cooperation. At the same time it can be argued that federal participation in urban problems is necessary from the standpoint of achieving national economic and social objectives. Clearly many national objectives will be achieved in urban areas by a predominantly urban population. In these circumstances the federal government cannot plead non-involvement in urban areas because of jurisdictional problems. It is this problem of defining the federal role in urban transportation in a way acceptable to provincial authorities that will concern the federal government immediately. Assuming the jurisdictional

problems are overcome in favour of federal participation then the practical urban transportation problems of rush hours, mass transit and efficient goods movement can be broached at the federal level. And even if direct involvement is not possible there is still the alternative of using the federal taxing and granting powers to influence urban development. Tax exemptions or special writeoffs on certain types of construction or conditional grants through CMHC are just two examples of this indirect but nevertheless powerful involvement.

CHAPTER VIII

INTERMODAL TRANSPORTATION

An important development in transportation in the next decade will be the increasing interchangeability of equipment between the various modes of transport. The main cause of this development is the growth of containerization which facilitates the transfer of commodities from one mode of transport to another with ease and efficiency.

The effectiveness of intermodal transport depends on the standardization achieved in the equipment used. Containers must fit the holds of ships, the flat cars of railways and the flat-beds of trucks to achieve effective intermodal transport. Fortunately this necessity has been realized early in the development of containers and internationally accepted standards have been adopted by many countries. However nonstandardized systems are appearing or have been developed which do not fit the international standards. The airlines for example, out of necessity, have their own size standards, although the sizes are consistent within the industry. Even here containers are easily loaded on trucks and since most air freight is flown from one destination to another, complete interchangeability with all other modes is not as essential as with containers in ocean trade that must be transported considerable distances over land. Therefore it is in the area of ocean trade that problems could arise if nonstandardized systems proliferate.

The chief restriction on standardizing air freight containers is the capacity of aircraft. Compared to trucks or railway cars, aircraft are limited in dimensions and containers must be designed to fit the aircraft. As future aircraft become larger further standardization with land modes will be possible.

Another feature of intermodal transportation is the complete restructuring of transfer areas. Ports completely change from manpower intensive areas where each piece of cargo is handled separately to a highly organized and mechanized operation where tons of cargo in containers are quickly shifted from one transport mode to another. The cargo, in fact, has become completely standardized. One commodity is moved and that is containers. The contents of the containers become, to some extent, irrelevant to the port operation.

Standardization is, naturally, not without problems. One of the most difficult to be overcome is the problem of filling containers both ways on a journey. Clearly, without containers, a heavy one-way movement of goods out of a port only creates a transfer problem one way. With containers, however, no matter what the balance of trade happens to be between two destinations, a balanced movement of containers must be maintained. Thus it may become necessary to perform transportation to move empty space. This facet of containerization could prove an inhibitor to its growth simply because it may be more efficient to use old methods that do not incur high costs of return transportation.

The full extent to which containers will be used in Canada is not yet clear. The main developments, so far, have centred around the ports, and most of these have not reached the operational stage. It is clear, however, that over the next few years port development for general cargo trade will be centred on building facilities for container handling.

The effects of containerization and its encouragement of intermodal operations is illustrated by Canadian development so far. One of the important aspects of container service facilities in Montreal, Quebec City, Halifax and Saint John is the participation and cooperation of a major railroad in each case. All of these ports will receive container-oriented train service when they are in operation. In one case at least, at Halifax, this rail service will be developed to the point of providing unit trains for containers to central continental destinations. For shorter distances, trucks will receive containers for forwarding to final destination.

Actual volumes of Canadian trade that may eventually be containerized are not yet known. It is known, however, that large tonnages of non-bulk traffic are suitable for transport in containers. In a 1968 survey "The Economist" estimated that up to 60% of ordinary non-bulk dry cargo could be containerized. They estimated that by 1980 up to 630 million tons of cargo in world trade would be moving in containers.(1) Furthermore, there are advocates of containers who feel that some bulk commodities would also be containerized. This may be particularly applicable in cases where a back haul is needed and the only commodities available are dry bulk products such as grain or asbestos bales.

Government Policy Implications

Some of the policy implications of container development have already been mentioned in the chapters on individual transport modes. For example, containerization could affect the economics of establishing a Canadian merchant shipping fleet. There are other problems, however, not directly related to modes of transport that were not mentioned earlier.

Development of container interchange points in an area in which the federal government will participate to some extent. Ports are the first obvious point of exchange where the government is active. The National Harbours Board has already made some commitments in this area. In the future the federal government may face decisions as to how many ports should be developed for container services and where the best location for these ports will be.

Going further than the ports, research may show that large inland interchange facilities for containers that could be used by all carriers, would be an efficient method of handling container traffic. In other words, it may be desirable to have inland exchange facilities similar to that of a seaport. The immediate question that arises is who should develop such facilities. If it is desirable for all carriers to have equal access, the government may consider whether it must participate, much as it participates in seaports, or whether it should be left to private developers.

Other questions that may arise from research underway in the Canadian Transport Commission at the present time are government policy toward container design standards and labour, although neither are necessarily transportation policy issues.

CHAPTER IX

OTHER TRANSPORTATION DEVELOPMENTS

Off-Highway and Recreational Transportation

The development of off-highway vehicles such as the snowmobile and the hovercraft and the adaption of these vehicles to recreational use will likely create some important regulatory and environmental problems. Already the snowmobile is becoming a serious safety hazard and both municipal and provincial governments are considering methods of effectively controlling these vehicles. Recreational hovercraft probably have an even greater potential for endangering public safety and creating a public nuisance. In addition there are commercial applications of these vehicles that may incur certain pollution hazards.

In that these recreational vehicles operate off-highway, actual control will be difficult. At the same time these vehicles have a potential for causing almost unlimited danger and nuisance. Beyond the problem of safety which so far appears to affect drivers of vehicles rather than innocent by-standers, there is a problem of noise that is very bothersome to many people. Problems may therefore arise in defining acceptable noise levels or creating areas where such vehicles are not permitted.

A more immediate problem that could arise for the federal government is the commercial use of hovercraft and tracked vehicles. More study is needed of the affects these vehicles are likely to have on the surface over which they travel, particularly in the Arctic during the season when the ground is not frozen. If these vehicles prove to be harmful the federal government will be responsible for regulations to control or prevent such damage.

Transportation and Economic Development

Most of this paper has concentrated on the analysis of the transportation industry itself and the internal factors influencing its development. However, transportation can be seen in the broader context, as an integral part of the national economy.

To illustrate rail transport is absolutely vital in ensuring the grain products of the prairies reach tidewater and that the bulk natural resources of Western Canada such as potash, coal and mineral ores reach their markets. In Eastern Canada the Seaway is a vital link for western grain, and for the iron ore required in the steel mills. The highway system can be seen as a vital communications link between people in various parts of the country and, of course, it is essential as a distribution network between factories and ultimately to the final consumer. Finally, the extensive air services provide the means by which business people can carry on efficient country-wide operations rather than being restricted to small provincial markets. In short, a thriving economy in Canada is vitally linked to an efficient transportation network.

There is another aspect of the close relationship of transportation and the economy that should be mentioned and that is the use of transportation as a tool in economic development. During the 1970's problems of regional economic disparity, growth of the urban economy and the opening of frontier areas in the North may all be areas where transportation policy could be used to influence the shape and extent of economic development.

Knowledge of the importance of transportation in influencing economic development is imperfect at the present time. Hopefully, this will improve to the point where the impacts of transportation policy and facilities can be accurately identified. Until this is possible the government will probably continue to struggle with evaluating the demands for new transport policies and facilities that are put forward in the name of economic development. New highways in economically depressed areas and railways to new frontier areas are two examples of this type of demand.

Transportation and Canadian Sovereignty

Another area where transportation might be used in other than a responsive way to real demand relates to national policy and the problem of sovereignty in the Canadian Arctic. If occupation is a necessary concommitant to sovereignty then it may be necessary for the government to invest in transport facilities in order to allow people to come and go from these remote areas. Thus expenditures on airplanes, airstrips, and possibly hovercraft will be necessary for more effective control of the Arctic regions of Canada.

Transportation Education and Research

Education, training and research in transportation may be one of the most fertile areas for improvement of the overall operation of transportation in Canada. There is probably a growing awareness of this necessity in that attempts are being made to establish research capabilities within universities and the teaching of transportation related subjects in both engineering and economics is becoming more common. However, the coverage is, as yet, very thin and very few students or transportation managers experience actual exposure to transport as a subject worthy of serious study. It might be useful, as a matter of policy, for government to consider expansion of its activity in this area of transportation. The Canadian Transport Commission, is moving in this direction by encouraging individual student research as well as giving some general support to universities that are active in the field, but these expenditures have so far been quite modest, amounting to a total expenditure of $130,000 in 1969-70 and a more substantial projected expenditure of $500,000 in 1970-71.

FOOTNOTES

CHAPTER II

(1) Camille Martin, "The Railways of Tomorrow", The World in 1984 Volume I, Nigel Calder, ed. Baltimore, 1965, pages 183 - 186.

CHAPTER III

(1) "A Review of the Economic Situation of Air Transport 1957-1967", ICAO Circular, July, 1968, page 24.

(2) "Ibid", page 25.

(3) R.K. Gamey, Long Range Forecasting of Domestic and International Boarding Passengers at Canadian Airports by Multiple Regression Analysis, Unpublished Thesis, University of British Columbia, April 1969.

(4) David A.D. Saarty, "Future of the International Air Charter Market" Paper to CTRF, May, 1969, page 4.

(5) ICAO Circular, July 1968, page 27.

(6) Transport Association of America, Transport Technological Trends, Washington, D.C., January, 1969, page 4.

(7) ICAO Circular, July, 1968, page 29.

(8) International Air Transport Association, Economics of Air Cargo Carriage and Service, October, 1969, page 46.

(9) Department of Transport, Canadian General Aviation, 1969-1980, 1969, pages 45 - 46.

CHAPTER IV

(1) T.D. Heaver, The Economics of Vessel Size, National Harbours Board, Ottawa, 1969, page 24.

(2) Dr. Hesashi Shinto, Ships, Canadian Transportation Research Forum, May 1968.

(3) Heaver, page 80.

(4) A.H. Evans, Technical and Social Changes in the Worlds Ports ILO Geneva, 1969, page 21.

(5) Heaver, page 80.

(6) Shinto, page 10.

CHAPTER V

(1) National Energy Board, Energy Supply and Demand in Canada and Export Demand for Canadian Energy 1966-1999, 1969, page 76.

(2) American Trucking Associations, American Trucking in 1980, 1968, page 10.

CHAPTER VI

(1) National Energy Board, Report to the Governor in Council in the Matter of the Application under the National Energy Board Act of Westcoast Transmission Company, Limited, March 1967, Appendix 6.

(2) Outlook for Energy in the United States, John G. Winger et al. The Chase Manhattan Bank, N.A. New York, 1968.

(3) Slurry Pipeline Economics and Application, E.J. Wasp & W.R.J. Fallow, CTRF, May 1969.

CHAPTER VII

(1) Urban Transit 1967, Dominion Bureau of Statistics, Ottawa, Queen's Printer, 1969, page 7.

CHAPTER VIII

(1) "Moving Goods", The Economist, September 14, 1968, page 14.

BIBLIOGRAPHY

Printed Sources

American Trucking Association. American Trucking in 1980. Washington, D.C., 1968.

Evans, A.H. Technical and Social Changes in the World's Ports. International Labour Organization, Geneva, 1969.

Gamay, R.R. Long Range Forecasting of Domestic and International Boarding Passengers at Canadian Airports by Multiple Regression Analysis. Unpublished Masters Thesis, University of British Columbia, April, 1969.

Heaver, T.D. The Economics of Vessel Size. National Harbours Board, Ottawa, 1968.

International Air Transport Association. Economics of Air Cargo Carriage and Serve. Montreal, 1969.

International Civil Aviation Organization. The Review of the Economic Situation of Air Transport 1957-1967. ICAO Circular, Montreal, July, 1968.

MacDonald, I.S. The Wide World of Aviation. Canadian Transportation Research Forum Paper, May, 1969.

Martin, Camille. "The Railways of Tomorrow", The World in 1984 Volume I. Ed. Nigel Calder. Baltimore, 1965.

Motor Vehicle Manufacturers Association. Facts and Figures of the Automotive Industry. Toronto, Various Issues.

Shinto, Dr. Hesashi. Ships. Canadian Transportation Research Forum Paper, May, 1968.

Saarty, David A.D. Future of the National Air Charter Market. Canadian Transportation Research Forum Paper, May, 1969.

Transport Association of America. Transport Technological Trends. Washington, D.C., January, 1969.

Wasp, E.J. and W.R.J. Fallow. Slurry Pipeline Economics and Application. Canadian Transportation Research Forum Paper, May, 1969.

Wheatcroft, Stephen. Further Airline Competition in Canada. Mimeo., Ottawa, 1966.

Winger, John G. et al. Outlook for Energy in the United States. The Chase Manhattan Bank, N.Y., 1968.

Government Publications

Department of Transport. Annual Report. Ottawa, Queen's Printer, Various Issues.

Department of Transport. Canadian General Aviation 1967-1980. Ottawa, Queen's Printer, 1969.

Dominion Bureau of Statistics. Civil Aviation. Ottawa, Queen's Printer, Various Issues.

Dominion Bureau of Statistics. Railway Freight Traffic. Ottawa, Queen's Printer, Various Issues.

Dominion Bureau of Statistics. Railway Transport, Part I. Ottawa, Queen's Printer, Various Issues.

Dominion Bureau of Statistics. Urban Transit 1967. Ottawa, Queen's Printer, 1969.

Dominion Bureau of Statistics. Water Transportation. Ottawa, Queen's Printer, Various Issues.

Dominion Bureau of Statistics. Transportation Service Bulletin Issue 1 (November 1969) and Issue 2 (March 1970).

National Energy Board. Report of the Governor in Council in the Matter of the Application Under the National Energy Board Act of West Coast Transmission Company, Limited. Ottawa, March, 1967.

National Energy Board. Energy Supply and Demand in Canada and Export Demand for Canadian Energy 1966-1999. Queen's Printer, Ottawa, 1969.

Public Accounts of Canada. Ottawa, Queen's Printer, Various Issues.

Periodicals

Canadian Aviation. Various Issues, 1968-69

"Moving Goods". The Economist, September 14, 1968, page XIV.